SCIENTIFIC AMERICAN

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ESTABLISHED 1845.

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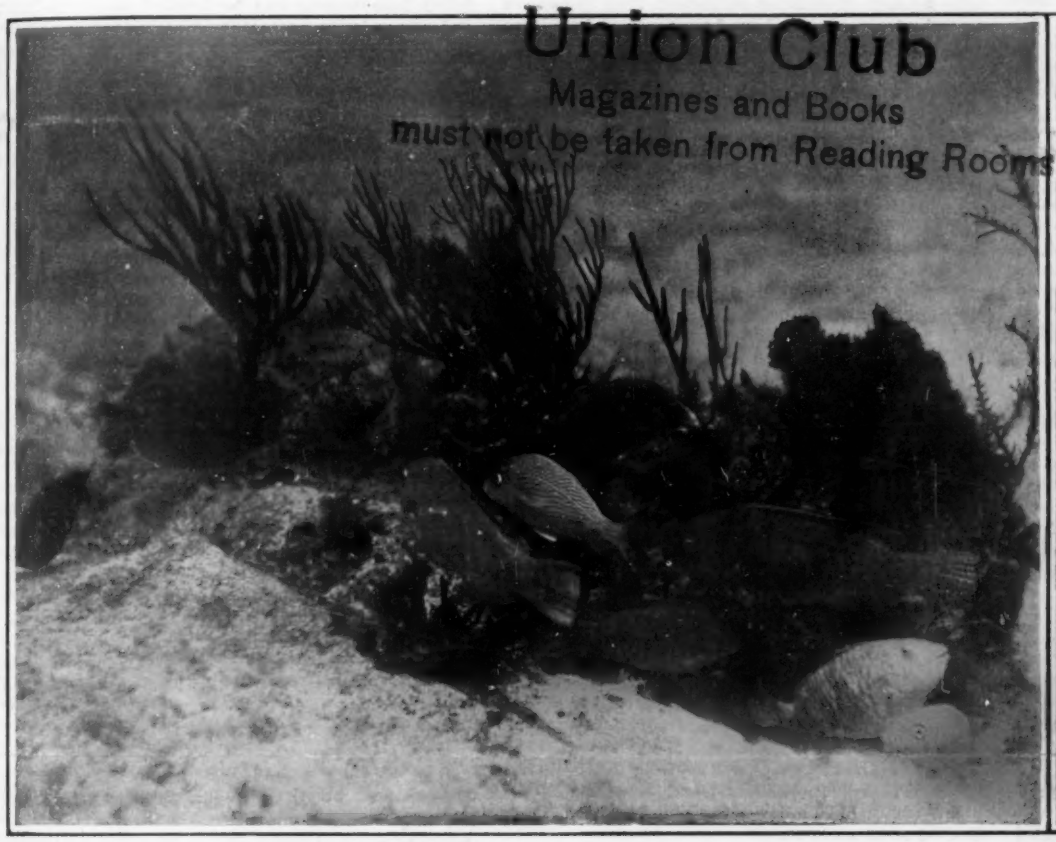

Fig. 1.—Photograph of subaqueous life taken with submerged camera.

Fig. 2.—Using the camera when inclosed in the watertight box.

Fig. 3.—Two-foot water glass for studying lampreys.

Fig. 4.—Photograph of sea bottom made with a submerged reflecting camera.

PHOTOGRAPHING ANIMALS UNDER WATER.—[See page 188.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

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NEW YORK, SATURDAY, FEBRUARY 13, 1909.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE LOCK-AND-LAKE CANAL APPROVED.

Our prediction that the Commission of Engineers which accompanied Mr. Taft to the Isthmus would report favorably on the present plan and construction of the lock canal at Panama, will in all probability be verified. Without exception, the reports which have been cabled from the Isthmus since the arrival of the Commission speak in the highest terms of the present condition of the work, and indicate that the expert engineers, after carefully looking over the ground and examining the reports of sub-surface investigation, are agreed that the canal will be finished by the date, January 1, 1915, which has been set by Col. Goethals and his assistants. As a matter of fact, if each of these half dozen highly-paid experts had remained in his own office in the United States, and there received the full plans of the work, the detailed reports of the several division engineers, and the samples of the material brought up by the borings, they would probably have made just as competent a report, and fully as favorable, as they will now turn in after walking over the ground in person.

However, it is possible that a few people have been disturbed by the intentionally misleading criticisms of the canal, which have been made in the public press; and the fact that this Commission has walked or ridden over the ground, will, no doubt, give an added amount of reassurance, when their final report is made public. Let us hope, however, that this is the end of the creation of special commissions to visit and report on the canal. Such expeditions are as costly as they are unnecessary. Either the army engineers are competent to build the canal, or they are not; their glowing reports of rapid progress and satisfactory conditions are either true or false. Everyone who is qualified to pass an intelligent judgment upon their work was satisfied, long ago, that they were both highly competent and that their reports were marked by scrupulous verity. We believe that the SCIENTIFIC AMERICAN voices the almost unanimous opinion of the people of the United States in its belief that Col. Goethals will complete the canal ready for opening on the day that he has named to the Commission.

CUBA'S DEBT TO OUR ENGINEERS.

For more reasons than one, it may be said that the improved conditions of the island of Cuba, as the result of American occupation, are due mainly to the American engineer. We say this without any disparagement of the most excellent work of an administrative character that has been done by the retiring Provisional Governor, Charles E. Magoon, whose genius for organization had been demonstrated at the Isthmus of Panama, before he assumed the difficult duties of his late office in Cuba. If we were called upon to name the directions in which American influence has been impressed upon the island with most immediate beneficial results, we would unhesitatingly name sanitation and transportation. By the cleaning up of the notoriously unhealthy city of Havana, to say nothing of other cities of less importance; by the brilliant work of our Army Medical Department in the extermination of yellow fever; and by the construction of railroads and highways, the United States has justified its political interference in the affairs of that sadly distressed country. The sanitary engineer has cleaned and repaved the streets, improved the water supply, and taught the Cubans how to dispose of sewage with the least possible risk to public health. The railroad engineers, under the leadership of that distinguished Canadian, Van Horn, have built a trunk line throughout the length of the island and equipped it with modern rolling stock; and now, under Governor Magoon, there has been constructed a complete system of macadamized roads of first-class quality, which not only includes a main artery running from end to end of the island, but provides at the proper intervals intersecting roads which extend from coast to coast, and serve to bring the whole island into touch with the inland towns and the cities of the seacoast.

Although it cannot be denied that our interference in the affairs of Cuba has brought certain valuable advantages to this country of a political and military character, our administration of the internal affairs of the island, and the fact that now for the second time we have voluntarily withdrawn from the active control of government, have been accepted both here and abroad as indisputable evidence of the sincerity and largely altruistic character of our relations with the island during the decade which has intervened since the Spanish war.

CONGRESS AND MILITARY AERONAUTICS.

In rejecting the bill for the appropriation of $500,000 for the purchase of balloons and aeroplanes for military purposes, the House of Representatives has given a serious blow to the development, in this country, of what we believe is destined to become, if it is not already, a most important branch of military operations. The failure of the bill to pass is due either to lack of interest or want of information; but probably to a mixture of both. To anyone who is conversant with the present state of the art of military ballooning as developed in France and Germany, it is evident that the matter is rapidly passing, if it has not already passed, from the experimental to the practical stage. For proof of this, we have only to refer to the fact that last year a balloon with a lifting capacity of 16 tons made a cross-country trip of 248 miles, during which, at times, a speed of 34 miles an hour was maintained; and that the machine which accomplished this feat was capable of carrying from fifteen to twenty people. Flights of approximately the same distance have been made by a smaller machine of the same general type, which has been developed in France. There are certain firms which stand ready to deliver war balloons, capable of carrying from six to eight people, and of making flights of from 200 to 300 miles at an average speed of 30 miles an hour. During the last year, moreover, an aeroplane made a continuous flight of over two hours, at a speed of 36 miles an hour, and other aeroplanes have made direct flights of nearly 20 miles, across country, at speeds of over 50 miles an hour.

The refusal of the House to encourage the development of military aeronautics will enable the foreign powers to gain a long lead over the United States, similar to that which they held at one time in naval and military affairs. We refer to that period, subsequent to the civil war, when the long neglect of our navy and coast defense, during a period of great development abroad, had not only placed our seaboard completely at the mercy of several European powers, but had even rendered us open to successful attack by the more ambitious of the South American republics. It has taken us over twenty years to bring our navy and our coast defenses up to a standard which is at all commensurate with our rank among the nations of the world; and it is well understood among naval and military men that an attack upon this country by a first-class naval power during the earlier years of this period of reconstruction must have inevitably spelled disaster.

It took Congress and the country at large a long time to realize that the building of battleships and fortifications is a matter, not of months, but of years; and that it takes years to enlist and drill the men, and educate and train the officers, to the point of efficiency at which they can get the very best results out of the war material which is placed in their hands. At the battle of Santiago, in 1898, out of every 100 shots fired, less than five per cent struck the enemy, and it has required ten years of training to raise the quality of our marksmanship to the average of sixty per cent of hits which now obtains.

Similarly, if the United States is content to sit back and let the foreign powers develop their fleets of aeroplanes and war balloons, and gain that experience in their manipulation which can come only by constant practice, it is liable to find itself in the same precarious condition as regards military aeronautics as existed in naval and military affairs during the period to which we have referred above. We have yet to make a serious beginning; and every year of neglect will count heavily in that future day, when, awakening suddenly to the true conditions, Congress begins to make lavish appropriations in the endeavor to remedy the supineness and neglect of the past. Aeronautics is a particularly difficult art. The navigation of the air, and particularly navigation for an offensive purpose, will make familiarity and long experience of even greater value than they are in the navigation and maneuvering of fleets and squadrons upon the high seas. It is our firm belief that in its refusal to grant the appropriation asked, Congress has lost touch with the attitude of the country at large.

THE HIGH-PRESSURE FIRE AUTOMOBILE.

The installation of a motor-driven hose tender for actual service test by one of the pioneer high-pressure fire companies in New York city is an event of considerable significance—not that automobile fire apparatus is particularly novel, for its use in both Europe and America is increasing rapidly, especially in the smaller cities, but because it indicates that in the conservative opinion of the fire authorities of New York city, who have too much at stake to risk premature experiments, it seems probable that the new heavy hose wagons can be handled more efficiently and economically by gasoline motors than by horses. The new high-pressure service renders available an adequate supply of water at the desired pressure at any hydrant in the protected district immediately after the receipt of the alarm at the pumping station. As soon as the firemen are at the scene of action and in position with their heavy hose, it is only a matter of time to quench a fire. It is necessary, however, that there should be no delay in transporting men and hose. If the motor wagon can get under way from the fire house, and carry as great if not a greater supply of the heavy hose and the crew of firemen more rapidly than the wagon drawn by three horses as ordinarily in use, it goes without saying that it works for increased efficiency, and that ultimately it must be adopted throughout the high-pressure district.

So far the motor wagon now in use has met the requirements not only under normal conditions, but with snow and ice on the streets. With a speed capacity up to 30 miles an hour, it has in many cases arrived at fires considerably earlier than the lighter horse-drawn apparatus. The reliability and freedom from breakdowns and repairs still remain to be demonstrated in actual use. In a few months the question of the general use of automobile apparatus in place of horses in the high-pressure districts of large cities will be definitely decided. This most recent fire department tender shows a great improvement on the large horse-drawn hose wagons added for the high-pressure service. It is larger and it has the same or additional hose-carrying capacity without the extreme width which made the maneuvering of horse-drawn wagons on narrow or crowded streets so difficult. It carries of course the turret nozzle or deck pipe, and shows a more practical arrangement of outlets for connecting hose lines, while its acetylene searchlight is available at night fires if needed as well as in running.

The new tender is without tools or appliances for coping with small fires or for entering closed buildings. This would seem a defect, in that the high speed of the motor tender will often bring it first on the ground at a small fire that may not require the heroic treatment of the high-pressure, or at a fire where a favorable position promptly secured by breaking or chopping into a building might enable an incipient blaze to be promptly suppressed. The high-pressure apparatus is really heavy artillery designed to deal with serious fires. It would seem to be a logical development to arrange for skirmishers, as it were, or firemen who could be carried to the spot on a special high-speed motor car fitted with extinguishers, chemical tanks, and a small amount of light hose, axes, door openers, and other tools, and possibly scaling ladders and ropes for the rescue of life, the general idea being to have the apparatus much more mobile and speedy than the modern ladder truck. This could precede the high-pressure tender with its heavy hose. If it carried an officer, he would be on the spot to direct the heavier apparatus as it came up. Thus time would be gained at a serious fire, not to mention the putting out of incipient blazes with a minimum damage by water.

THE NEW YORK MOTOR BOAT SHOW.

The annual Motor Boat Show under the auspices of the National Association of Engine and Boat Manufacturers will be held this year in Madison Square Garden, New York, from February 15th to 23d. Over 150 builders of marine engines and all kinds of pleasure craft will exhibit. Several of the most successful racing motor boats will also be shown. In this connection it is interesting to note that the racers "Standard" and "Dixie II," the latter of which won the Harmsworth Trophy in the international race in Long Island Sound last summer, will be sent to Monaco to contest in the international races there from April 4th to 11th. The "Dixie II" has been remodeled, while the "Standard" is a new boat designed by Clinton H. Crane, and fitted with a double-acting 6-cylinder engine and four magnetos.

Filling Mass for Wood Pores.—To 1 part each of oil of turpentine and siccative, add 1½ part of linseed oil varnish, ½ a part of oil of varnish and 5 parts of starch.

ENGINEERING.

It is to be hoped that Congress will grant the appropriation asked by Oscar S. Straus, Secretary of Commerce and Labor, for lighting the new Ambrose Channel entrance to New York Harbor. It would be possible to do this so thoroughly that steamships could enter the harbor with perfect safety between dark and dawn. The plan proposed contemplates the laying of acetylene gaslight buoys at frequent intervals, and it is estimated that the work could be efficiently done for an expenditure of $80,000.

The annual report of the New York State Water Supply Commission proposes an amendment to the constitution to permit the State to build enormous reservoirs for storage and flood prevention on the upper Hudson, the Genesee, and the Racquette rivers. The commission declares that, with the complete storage of all available water supply, an eventual development of not less than 1,500,000 horse-power is assured to the State. It is confidently believed that the reservoirs would be built by the property owners benefited, who would pay a fair rental to the State for all time if they were assured of a permanent source of power.

In a recent lecture before the Royal Institution, John Oliver Arnold, professor of metallurgy at the Sheffield University, made light of Carnegie's recent prediction of an early decadence of the British steel industry. He stated that, among other developments, a new steel had been produced in Sheffield that was so far superior to existing steel, that the best high-priced steel at present in use would soon be quite out of date. Within a year the market would probably be supplied with steel whose cutting power was about four times as great as any now known, tests having shown that the new steel was capable of cutting for a whole day without regrinding.

Once more, after an interval of six years, the English railroads have achieved the remarkable record of carrying on their operations for a whole twelvemonth without the loss of a single life. The last period in which this was achieved was the year 1901. In 1902, 6 lives were lost; in 1903, 25; in 1904, 6; in 1905, 39; in 1906, 58; and in 1907, 18. As a matter of fact, there has been no loss of life for fifteen months past. The relatively large number of fatalities in 1906 was mainly the result of three disasters, which were found, upon investigation, to be due entirely to the failure of the human element, all the mechanical arrangements on train and track being found perfect.

The fifth tunnel to be driven below the Hudson River between Jersey City and Manhattan was completed on January 27th of this year, the final blast which established connection between the two sections being set off during the afternoon of that day. This is the east-bound of the twin tubes which are being built between Jersey City and the Hudson Terminal at Cortlandt and Church Streets, Manhattan. If the expectations of the company are fulfilled, the west-bound tube will be opened in about three months' time, and the completed tunnel will be at the service of the public early next July. The western terminal of these two tubes is located eighty feet below the present terminal station of the Pennsylvania Railroad Company in Jersey City, and the distance between terminals is about 6,000 feet.

The report of the Public Service Commission on the subject of fender and wheel-guard tests, held last autumn at Schenectady and Pittsburg, showed that nearly 200 applications were received from inventors and manufacturers, and that 92 devices were submitted. Altogether, 1801 tests were made of 38 fenders of the projecting type, and 29 wheel guards. It is estimated that the cost of equipping all the surface cars of New York with the best type of life-saving devices will not exceed $300,000. Although this is a large sum, the report points out that the companies operating such cars in New York city incurred expenditures for injuries, damages, and legal expenses, during the year 1906-7, of more than $3,500,000. Much of this might have been saved by the introduction of proper fenders and wheel guards.

London for two centuries past has been the leading port of the world. The tonnage entered in 1907 was 11,160,367, and the tonnage cleared amounted to 8,598,979, making a total trade of 19,759,346 tons. The trade for the port of Liverpool for the same year reached a total of 16,665,398 tons. The value of the trade at the port of London for 1907 was $2,430,000,000; the total for New York city for the same year being $1,709,164,423. For many years London has spent comparatively little money upon the improvement of its port facilities, although Liverpool has spent $25,000,000, Plymouth $12,500,000, and Southampton $10,000,000. Hamburg, moreover, has laid out $75,000,000 in recent years, and Antwerp contemplates an expenditure of $35,000,000 on new docks and facilities. At last, however, Parliament has passed the port of London bill, which has set up a new Port Authority consisting of twenty-eight members; and it is likely that vast improvements, which have long been contemplated, will now be undertaken.

ELECTRICITY.

Owing to the success of its system of training for railroad employees the National Railway Training Association of Kansas City, Mo., has enlarged its field, and now gives a correspondence course in the duties of electric railway employees.

Because the American-Canadian Company, of Rio de Janeiro, operating the city railway system, changed its fares and routes, a mob burned twelve of its cars on January 11th. The police were helpless. The company left the adjustment of affairs in the hands of the mayor, and quiet was restored.

Prof. C. F. Burgess in a paper read before the Western Society of Engineers supports the theory that practically all kinds of corrosion of iron and steel, including that in steam boilers, may be accounted for by electrolysis. He says that difference of temperature, difference of chemical composition, or simply difference of treatment in manufacture between different parts of a structure, causes sufficient difference of potential to set up galvanic action.

A new flexible non-metallic conduit, known as "wire duct," has been invented, for which there should be a very wide field, if all the claims made for it can be substantiated in practice. Its fiber inner tube is attached to the middle tube by means of a helical bond, which entirely prevents its being pulled out on wires being threaded through it; and the whole, while entirely non-conducting, has great flexibility and strength to resist both tensile strain and abrasion.

An interesting exhibit at the recent Automobile Show, which may have escaped the notice of the more superficial sightseer on account of its situation in the basement, was that of the electric automobiles of the General Vehicle Company of New York. The five commercial vehicles exhibited include everything from a light delivery runabout of 350 pounds load capacity, a range of 50 miles, and a maximum speed of 14 miles an hour, to a 3½-ton truck of 35 miles range and a speed of 7 miles an hour. These machines represent a considerable advance, both in simplicity of operation and in range of travel on a single charge.

The remarkable growth of the steam turbine is well illustrated by an interesting article in the January Electrical Magazine describing the immense works of the Parsons Steam Turbine and Electrical Company at Heaton and Wallsend near Newcastle-on-Tyne, this mushroom growth among the century-old industries surrounding it occupying 16 acres. The simultaneous improvement in efficiency and increase in size of units is diagrammatically shown in a striking manner, from the first 10-horse-power turbine of twenty years ago, consuming 50 pounds of steam per kilowatt hour, to the 6,000-horse-power units of to-day, using only 14 pounds per kilowatt.

The rapidly increasing use of electric power is remarkably illustrated by the report of the U. S. Bureau of Census upon street and other electric railroads, recently issued for 1907. It shows 4,714 establishments, as compared with 3,620 at the end of 1902, an increase of 30 per cent., of which 1,252 are municipal, the latter having increased by 53.6 per cent. The total mileage of main line is 25,547, compared with 16,651 in 1902, an increase of 53.4 per cent.; and the passengers carried total 9,533,080,766, an increase of 63.3 per cent. The fact that the total output of stations, four and three-quarter billion kilowatt hours, has increased by the much larger percentage of 110.3, would indicate an increasing sale of power for commercial and domestic purposes other than traction, while the total income of all plants having been more than doubled for an increase in plant cost of less than 100 per cent, is a tribute to the efficiency of both plant and management, as well as to the flourishing state of the industry.

The fact that the above-mentioned report shows the electrical energy generated by water power to have increased by 207.3 per cent, while the steam and gas engines, including turbines, used in the same industry, have increased only 92.8 per cent in total power, gives color to the statements made by President Roosevelt in vetoing a bill to authorize the construction of a dam across the James River in Missouri for the purpose of electric power. The President states that 19 per cent of the total natural water power now in use is controlled by thirteen large corporations, of which the General Electric and Westinghouse companies are the chief, and that further evidence in the possession of the Bureau of Corporations affords reasonable ground for supposing that these thirteen concerns directly or indirectly control developed water power or advantageous power sites aggregating 33 per cent of the total now in use. This state of things will, unless controlled, lead to a repetition in the hydro-electric power industry of the history of the oil industry in this country, and with results far more oppressive and disastrous to the people. The General Electric Company has, however, issued an emphatic disclaimer of any knowledge of or interest in a water power trust, and states that it controls no water power except that supplying its manufactory at Schenectady.

SCIENCE.

Prof. George E. Hale, of the solar observatory of Mount Wilson, California, has been appointed a delegate to represent the National Academy of Sciences at the Darwin celebration at Cambridge, from June 22d to 24th, 1909. He will also lecture at Columbia University in April on cosmic evolution, in commemoration of the Darwin centenary.

The reversal by the referee board of consulting scientists of the findings of Dr. Harvey Wiley, and its statement that benzoate of soda, when used as a preservative for foodstuffs, is not a poison, has been made the subject of considerable criticism in the Senate. It is pointed out that while the investigation carried on by the referee board lasted four months only, Dr. Wiley's experiments consumed nine months. In justice to Dr. Wiley it must be stated that he has never claimed quick action for preservatives, but that their danger lay in the ultimate effect which they produced from constant use.

The production of petroleum in the United States in 1908, according to a preliminary estimate made by David T. Day, of the United States Geological Survey, amounted to between 175 and 180 million barrels, an increase of between 5 and 9 per cent as compared with the production of 166 million barrels in 1907. The total value of the product showed an even greater proportionate gain, for the price of oil increased in California and remained steady in other fields except the Gulf. The increases are attributed to steady growth in Illinois and California, though neither field showed phenomenal development.

According to Prof. Percival Lowell, at certain seasons of the Martian year white spots permanent in place and persistent in character show themselves upon the ground of the planet. Though not restricted to any one zone, they are remarkably attached to localities, and recur year after year in the same places. A natural supposition is that they are snow-fields or glaciers collected on high mountain summits. Such explanation of them might indeed be plausible, but for one objection: that there are no mountains on Mars. Of this fact we have assurance by the absence of any evidence of peaks at the times when of all others they could not fail to betray themselves did they exist, to wit: when they are passing the sunrise or sunset edge of the illuminated disk. By this means we are able not only to gage their possible existence but to ascertain their height, and in consequence we are assured that no elevation worthy the name of mountain exists there. Furthermore, since the air thins out relatively much more slowly on Mars in consequence of the planet's lesser gravity, a much greater elevation would be necessary to accomplish the same climatic result.

M. Ogawa, of the University of Tokio, has discovered a new element in the minerals thorine, reinite and molybdenite. The name nipporium and the symbol Np have been given to the new element. Its combining equivalent is about 50 and its atomic weight is some multiple of that number, probably 100, which would give it a place between molybdenum and ruthenium in the periodic series. It appears to form two oxides, of which the lower possesses basic properties and is very difficult to separate from alumina, and the higher is an acid-forming oxide, analogous to molybdenum trioxide, and readily reducible to the lower oxide by the action of zinc and hydrochloric acid. Nipporium occurs in thorine in the form of small yellow or red crystals, hard enough to scratch glass, having a density of 4.5 and composed of a double silicate of nipporium and zirconium. These crystals constitute one per cent of the weight of thorine.

Ocean currents can be traced by throwing into the sea, at various points, sealed bottles containing records of the date and place at which they were abandoned. When these bottles are found on the coasts or picked up by ships, they furnish data for the calculation of their probable course and the time occupied in accomplishing the journey. The Hydrographic Bureau of the United States, for the purpose of obtaining a great many such indications from which a general scheme of ocean currents may be deduced, supplies ship captains with bottles containing blank forms on which the date and latitude and longitude of the place are inscribed when they are thrown overboard. The captain of the ship "Emma Laurans" has published in The Yacht a note on the wanderings of one of these bottles which, thrown overboard by him on March 24, 1906, at 51 deg. S. lat. and 48 deg. 40 min. W. long., was picked up more than thirty months afterward on September 2, 1908, near Robe, in southern Australia, in about 37 deg. S. lat. and 140 deg. E. long., having traveled 14 degrees in latitude and nearly 189 degrees in longitude. It would be very interesting to know the precise route followed by the bottle, but the precise route is never given by these experiments, as they are conducted at present. If all captains who find these floating bottles would set them adrift again after recording the place and date, more could be learned of their wanderings and, consequently, of the course of ocean currents.

PROJECTING MOVING PICTURES IN THE LIGHT.

BY JACQUES BOYER.

The projection of moving pictures in the light is an accomplished fact. A method patented by Quentin is employed at the Cinérna Palace in Paris. The screen, measuring 8 feet by 10 feet, is a part of the rear wall of the hall which is painted white, very slightly tinted with rose, and is protected more or less from the glare of the footlights and the electric lamps by adjustable curtains (Fig. 1). The projection cabinet (Fig. 2) is supported by two iron columns, about 10 feet high, at the other end of the hall, which accommodates 350 spectators. The arc lamp used for projection is 66 feet from the screen, and normally takes a current of 30 amperes from the mains of a 110-volt circuit. Half the lamps of the theater are lighted, yet the projected pictures, both stationary and moving, are seen very well, and the eyes are less fatigued than if the hall were dark.

In Belgium, De Mare has invented a system of projecting fixed pictures in daylight which he calls by the English name "Without Darkness." The screen is arranged, like a scene of a theater, in the frame of a pair of folding doors, the projection apparatus being concealed from the spectators, who occupy a room lighted by two large windows. Excellent results were also obtained when the apparatus was set up in a shed, the spectators being in the open air. A current of from 7 to 9 amperes per square meter (about 11 square feet) is required, according to the inventor, and even 5 amperes suffice for a room having no window opposite the screen. This system has already been initiated in France and will probably soon reach Paris.

Meanwhile, other devices are being patented almost daily. In the method of Antoine and Prosper Poch, which may be used for fixed or moving pictures, in illuminated halls or in diffused daylight, the image is thrown on a translucent screen between the spectators and the lantern, and forming the front wall of the projection chamber. If the screen is of ground glass the ground face should be turned toward the spectators. The pictures are seen very distinctly (Fig. 3). In some cases it is advisable to diminish the quantity of light that enters the projection chamber through the screen by placing outside the latter a slightly smoked glass, which also softens the harshness of the white parts of the picture. The other walls of the chamber are opaque. In an apparatus devised for demonstration, these walls are made of black cloth sliding on rods (Fig. 4). An ordinary moving picture apparatus, with an arc lamp consuming 15 amperes at 110 volts, covered a screen measuring 32 by 24 inches with pictures clearly visible to spectators in the open air at two o'clock on a partly cloudy afternoon.

But the projection on translucent screens of images visible to spectators in lighted rooms is not new. It was accomplished in 1897 by the artist Lemot, with a screen of fine canvas saturated with gelatine and covered with copal varnish. Chamayon made what he called "rainbow screens" by a process which has long been public property and which consists in saturating white fabrics, thin or thick, with fish glue and lining them with thin tinted stuff.

Very good translucent screens can be made by the tracing cloth used by architects.

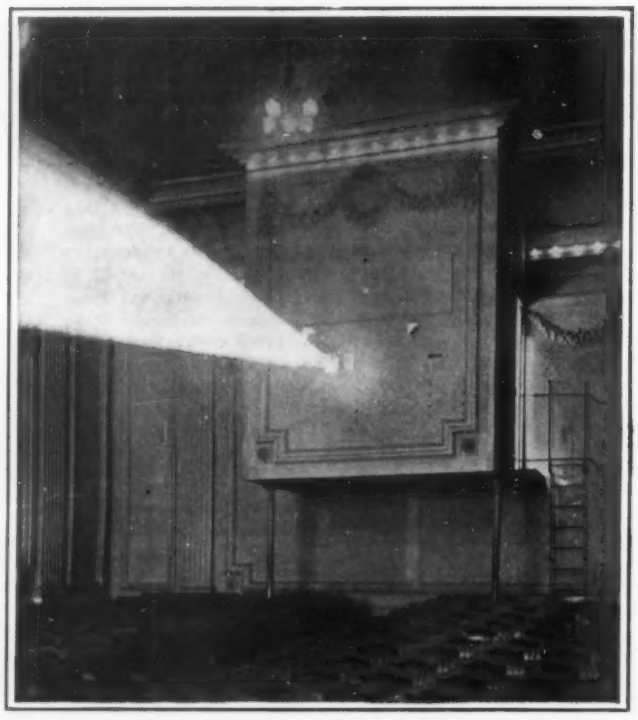


Fig. 2.—Projection cabinet, Cinérna Palace.

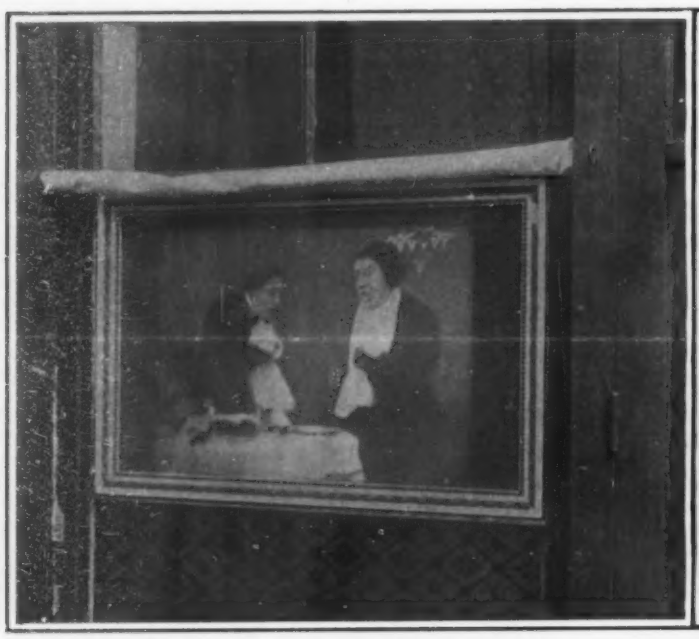


Fig. 3.—Moving pictures visible in daylight.

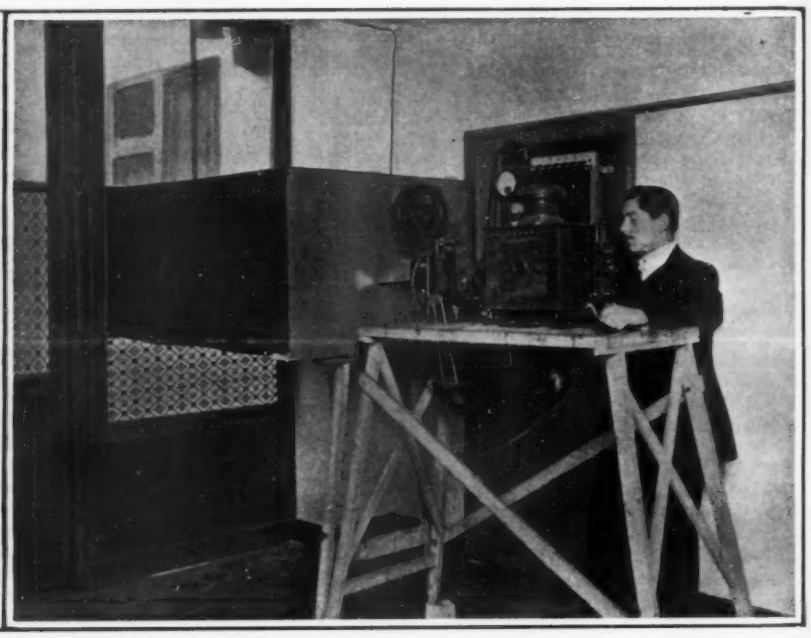


Fig 4. Poch's apparatus for demonstration.

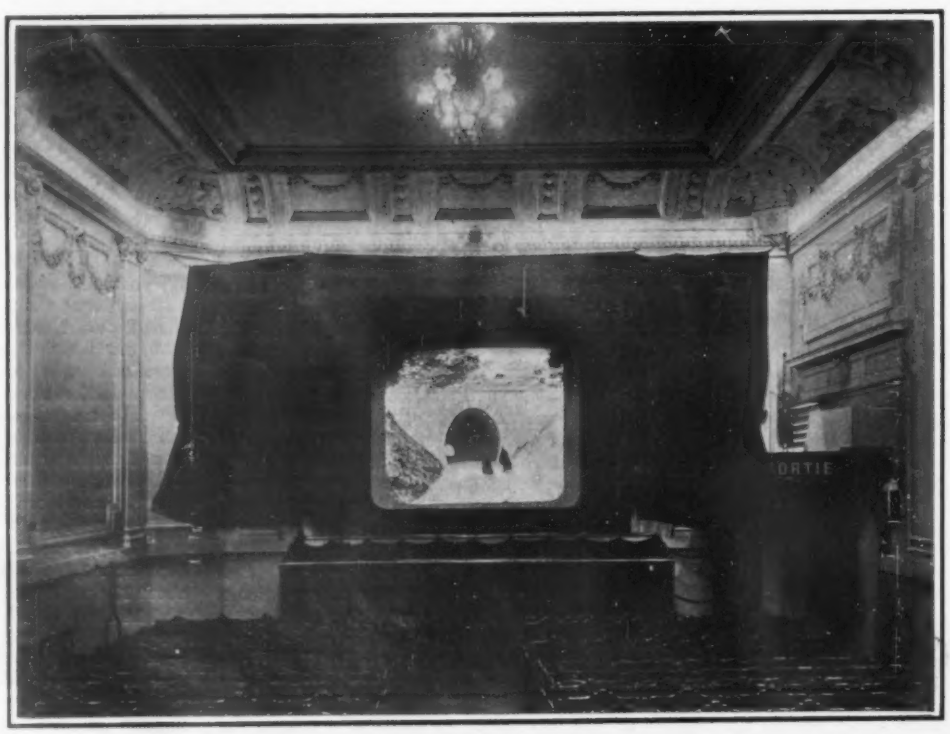


Fig. 1.—Moving pictures shown in the lighted auditorium of the Cinérna Palace in Paris.

PROJECTING MOVING PICTURES IN THE DAYLIGHT.

Waterproof Fabrics.

Fabrics are waterproofed by impregnating them with metallic salts, by coating them with oil, grease, and wax, by coating them with India rubber, or by treating them with ammoniacal solutions of copper. The first process is applied to sail cloth. The canvas is impregnated with alum or calcium acetate, and then immersed in a fixing bath containing soap, which forms insoluble lime or alumina soap in the cloth.

The second process is used for raincoats, imitation leather, etc. The fabric passes between hot rollers, and then over a cylinder of wax, etc.

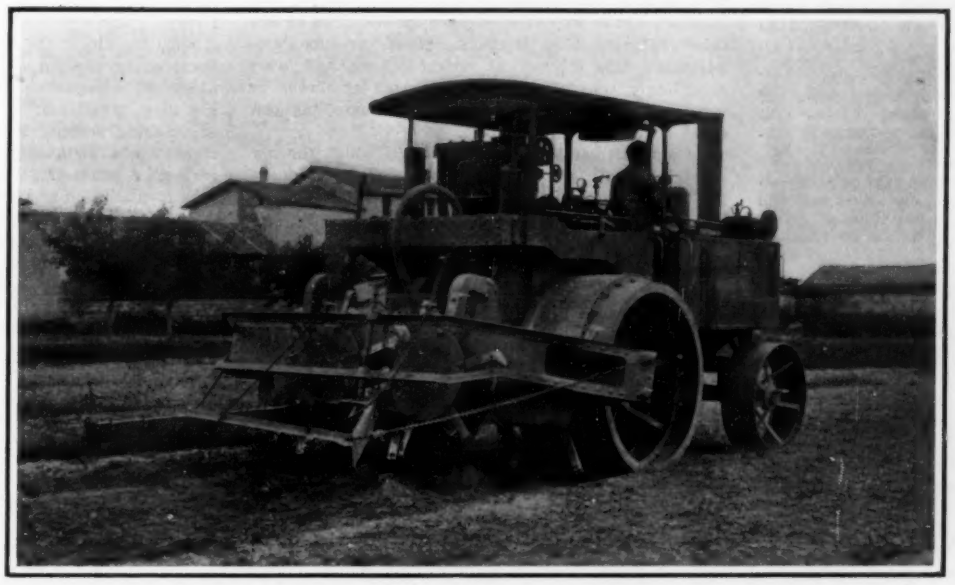
In the third process a solution of India rubber in carbon disulphide, chloroform, or other solvent is applied. This process is used for mackintoshes and bathing caps and is also applied to thread.

In the fourth process, employed in the manufacture of book bindings and Willesden canvas, cotton cloth is run through a solution of oxide of copper in ammonia which dissolves the superficial layer and, on evaporation, leaves it in the form of a uniform coating of cellulose. The process is completed by passing the cloth between rollers. There are still other processes but these are the most important.

AN EGYPTIAN STEAM CULTIVATOR.

BY OUR CORRESPONDENT IN PARIS.

The steam cultivator illustrated in this article was designed by Boghos Pacha Nubar and is noteworthy for its original construction. The principles involved in it are an advance over what has been hitherto produced in the way of machines for working the soil. There are now several of the cultivators of the type illustrated herewith in actual use upon the farm lands of the inventor in Upper Egypt, and he is having others constructed. In this machine he uses the ideas involved in the researches of M. Déhérain upon the pulverization of the soil and the necessity of thorough stirring and also of aerating it at the same time that it is broken up. The cultivator is formed of a road locomotive having wide wheels and carrying in the rear a very strong U-shaped channel-iron frame. This is used to support the plowing parts, and it is pivoted upon the rear axle so that it can be raised or lowered. It also supports the gear mechanism for driving the plowing apparatus, and the mechanism is well protected from dust by a tight casing which surrounds it. For working the earth there is used a set of cutting blades which are curved at right angles at the ends, and which are fixed upon disks of iron plate. The disks are set in motion by means of a gear drive at a moderate speed, and when the framework is lowered, the blades sink in the ground and are thus made to cut the earth by upturning and breaking it so that the earth is left in a well-divided condition.



View showing the cultivator wheels lifted to clear the ground.

Rear view. The ground is broken up by the radiating arms on the disks.

AN EGYPTIAN STEAM CULTIVATOR.

Two of the rotating disks will be noticed outside of the framework, where they are mounted close together. Behind them are mounted two similar disks inside the frame, and these are spaced farther apart by about half the diameter of the disk. At the back of the frame are placed two other disks, these being mounted at the exterior and near the rear wheels of the cultivator. In this way the ground is cut up the width of the cultivator by all the six disks working together. The head disks accomplish the first cutting and the operation is completed by the rear disks as they pass through the same earth. In this way the ground, after it leaves the rear disks, is well broken up. A countershaft runs across the framework and it is driven by a chain from the revolving rear axle. To the countershaft are connected the shafts of the six cutting disks by means of both spur and bevel gears.

As the disk frame can be raised or lowered at will, the earth can be cultivated to any desired depth up to 12 inches as a maximum. An official trial of the cultivator was made under practical conditions of working, and the tests were carried out by a special commission appointed for the purpose by the Khedival Agricultural Society. The experimenting ground of 25 acres was at Choubra, near Cairo. The soil was of a clayey nature and very compact, so that it was difficult to work. The cultivator, when passing across the field, left behind a well-worked band of earth of 11 feet in width, and the result was the same as would be secured by at least two plowing operations carried on successively by means of steam-operated plows driven by cable, or three plowings with the customary ox-plows of the country. It was found that the cultivator worked 1.58 acres of ground per hour, which, for a day of ten hours, represents 15.8 acres. During the tests the average depth of working the soil was 9 inches. Using a very ordinary quality of briquette coal for the engine, it was found that the amount of combustible employed was 220 pounds per acre. The ground had been previously planted in clover and had not been watered for three months, so that it was very dry and hard. With a single passage of the cultivator the ground was so well broken up that it was only necessary to pass over it with a roller and to make the furrows for planting the cotton. Another point which is worthy of notice is that the machine worked to good advantage in connection with fertilizers. It was found that when any fertilizer was spread on the field before plowing, it was thoroughly incorporated with the ground after the passage of the plow, and this took place throughout the whole depth of the furrow. The cost of the work per acre, for coal, oil, and personnel, including an engineer, fireman, and helper, also for the water tank cart which followed the machine, and two men and a mule, figures out to $4 per acre, or $13 per day of 10 hours. Out of the total time of 35 hours working, about 7 hours, or 20 per cent, was taken for the water supply, even though the water was drawn by means of a good injector. At present this loss no longer occurs, as the cultivator is followed along its course by the tank cart containing 200 gallons, and the water is taken by the machine without stopping by means of an injector and hose which passes to the tank. A deduction should therefore be made for this reason from the above figures for the cost per acre.

A series of official tests which were made at Milan at the time of the recent exposition also showed the application of the new machine to different kinds of fields. In one, the cultivator was run upon a field which was quite covered with very thick and high weeds, and these it pulled up and threw to the surface while plowing, so that when the operation was finished it only remained to pass the harrow over the ground in order to clean the field. As a general thing the farmers of the country using ordinary plows are obliged to carry out a surface plowing so as to remove the weeds, then to take these off by means of the harrow, and only after this is done can they begin the real plowing of the field. In general, these tests confirmed the results obtained by the Khedival Commission.

The inventor is having a new type of cultivator built. This contains some minor improvements over the one shown—improvements based on the results of numerous trials. One of the main improvements is the use of a 2-cylinder horizontal steam engine to replace the present vertical engine. This is mounted on the chassis as in the case of a locomotive. The change in the engine and its location was for the purpose of giving more room and better access to the different parts of the engine.

Protective Coating for Metals.

Steel, iron, bronze, brass, and copper may be protected from the oxidizing action of the air by the following cheap and simple method: The surface of the metal is cleaned, first with lye and then with dilute sulphuric or hydrochloric acid. A thin paste composed of a metallic powder mixed with water or other suitable liquid is then applied uniformly, with a brush for small objects and with a compressed air sprayer if large surfaces are to be covered. The metallic powder is composed of tin, pure or alloyed with lead or with lead and zinc. The metallic coating is next melted by means of a flame or a coke or charcoal fire. The moment of fusion is indicated by the change of color from gray to black. In order to avoid danger of burning off the coating it is advisable not to heat much above the fusing point. After the surface has cooled, it is washed with water. A glossy surface may be produced by friction with a brush or with tow.

Wrought iron and steel must be washed with sulphuric acid and, in some cases, a thin coating of copper must be applied by brushing or spraying with a slightly acid solution of copper sulphate and immediately washing with water before the tin is applied. Cast iron must be attacked with hydrofluoric acid before the washing with sulphuric acid, and electroplated with copper before tinning.

Standardization of sparking plugs for automobiles has been attempted by the American Association of Licensed Automobile Manufacturers. The mechanical branch of this association for some time has been working on proposed standards for the dimensions. The form now agreed upon has a ¾-inch diameter of thread, 18 pitch, a shouldered or flanged seat 1¼ inch in diameter, a minimum length below the shoulder of ½ inch, and a hexagon head ⅞ inch across the flats.

THE OPPOSITION OF MARS IN 1909.

BY FREDERIC R. HONEY, TRINITY COLLEGE.

The prospect of another favorable opposition of the planet Mars in the near future, while the memory of the observations which have been made recently is still fresh in the mind, will encourage observers of this interesting planet not to spare any effort in the endeavor to learn all that is possible regarding its surface markings. If the opposition of July, 1907, was a favorable one, that of September, 1909, will be still more so; for the planet this year will come nearly two million miles nearer the earth.

In a plot of an orbit which is constructed within the limits of this page, and in which very great distances are represented by very short lines, it is difficult to exhibit to the eye a difference of two million miles. If the plot be made carefully, however, this difference may be measured, and will correspond to scale with that which is found in the Nautical Almanac. The axis of the earth's orbit *A P* (Fig. 1) represents nearly 186,000,000 miles; and the nearest approach of Mars to the earth's orbit, which is near the perihelion *P*, is a distance of about 35,000,000 miles.

On August 21, 1908, the planet was near aphelion *A*, and at its maximum distance from the earth. If the sun were out of the way, it could be represented as in Fig. 2 at the date attached. After this, Mars became morning star and increased in apparent diameter, presenting the gibbous phase. The apparent diameter is inversely proportional to its distance from the earth. Between August 21 and October 21 the planets were moving in opposite directions, and as a consequence on October 21, two months after conjunction, the distance between them was not sufficiently diminished to greatly increase the apparent size. After December 21, as the distances between the earth and Mars diminish, the diameter increases rapidly until opposition is reached. Since this occurs near the close of the day (the 23d) the date of opposition given in the Almanac, the positions of the earth and Mars are shown for the 24th; i. e., at the beginning of the following day. On account of the eccentricity of the planet's orbit, the minimum distance is reached six days *before* opposition. For the same reason, in July, 1907, the minimum distance was reached a week *after* opposition. In order to compare the distance between the earth and Mars at the opposition of 1907 with that of 1909, at the former date the positions of the planets are indicated in the plot; and the effect of the diminution of distance in increasing the apparent diameter at the latter date, is shown in Fig. 2.

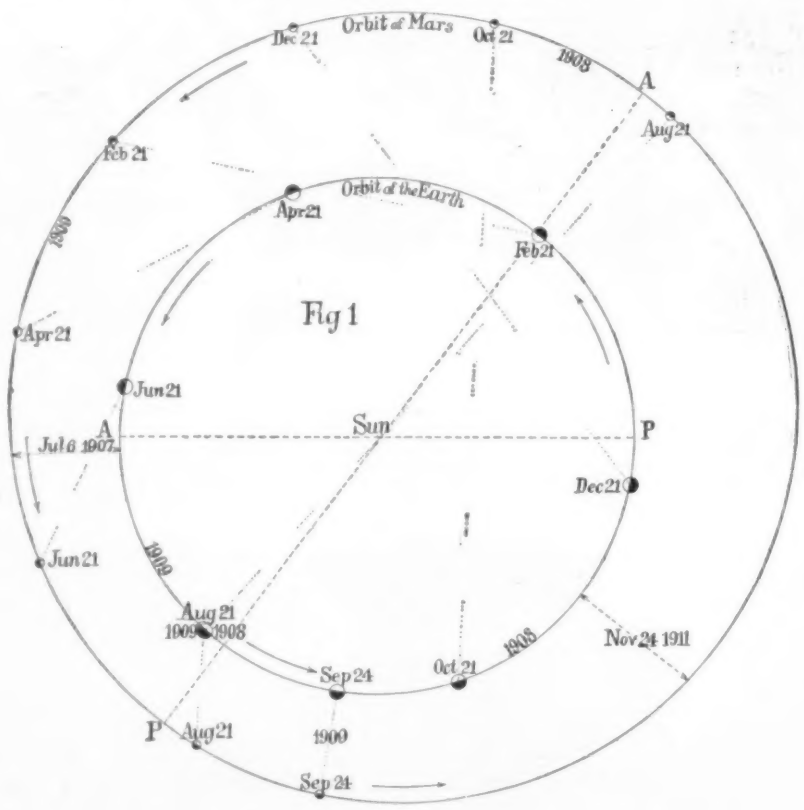
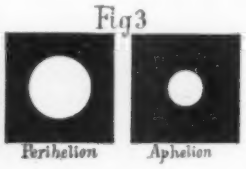


Fig 2

Fig 3



THE OPPOSITION OF MARS IN 1909.

An opposition unfavorable for observation would evidently occur when Mars is near aphelion *A*, and when the distance between the planets is about 61,000,000 miles. Fig. 3, drawn to the same scale as Fig. 2, shows the apparent diameter of Mars at the most favorable and unfavorable opposition, i. e., when the planet is near perihelion and aphelion. The distance varies between 35,000,000 and 61,000,000 miles. The diameter is diminished in the proportion of 7 : 4; and the area of the planet's disk in the proportion of about 3 : 1. At an aphelion opposition the apparent diameter of the planet is not very much in excess of that which is shown for June 21, three months before opposition occurs this year.

The positions of the earth and Mars are shown for the opposition of 1911, which will occur on November 24. On account of the eccentricity of the orbit, the planets will be separated by their minimum distance a week sooner, when the apparent diameter will be less than that which corresponds with August 21, and greater than that of June 21, 1909.

The illustrations here given are designed to call attention to the rare opportunities which are afforded the inquiring student of astronomy by the oppositions of 1907 and 1909. The present times afford exceptional advantages in the study of our celestial neighbor, being midway as we are between two remarkable oppositions. Thus for the practical observer and the theorist there is opened an extensive field for inquiry and speculation. The positions of the earth and Mars at the dates of oppositions during the past seventy-five years if plotted would show that oppositions occur on the average at intervals of two years and fifty days; but owing to the eccentricity of the planet's orbit, there is a great variation in the lengths of these intervals.

The Postal Department and the Automatic Stamp-Vending Machine.

To the present Postmaster-General of the United States is due the first comparative investigation of coin-controlled stamp-vending machines for government use. A few months ago a number of promising machines were tested at Washington with a rigor that was bound to expose any inherent defects. To an official whose specialty seems to be the legal rifling of such apparatus was assigned the task of robbing each machine, either by means of counterfeit money or slugs, or by inserting thin instruments through the slots in order to operate ratchets and levers, so that stamps could be extracted without the insertion of any coin whatever. Most of the machines were unable to withstand this mechanical pocket-picking, and were accordingly rejected. Others were too cumbrous or were so complicated that only a graduate engineer could buy a stamp from them.

As a result of this investigation, in which the machines were abused as no thief could ever abuse them, the Postal Department finally selected a simple automatic apparatus, which resists the most ingenious attempts to rob it of its contents, which rejects foreign or defective coins or slugs, and which does not depend for its operation on any power or winding device. The mere insertion of a coin is the only function which the purchaser of a stamp is called upon to perform.

The apparatus selected in reality consists of three machines compactly inclosed in a single casing and designed to sell one, two, and five cent stamps. The lower part of the casing is a letter-box, in which the stamped letter may be deposited. The first machines which the Postal Department has ordered will be installed in large hotels. In all probability similar machines will soon be found in almost every drug store and public institution.

An Important English Patent Decision.

A case has recently been decided in England under the compulsory working clause of the new British patent law, in which it is held that in order to comply with the act the whole machine must be manufactured in the United Kingdom, and not merely certain parts. The applicant for revocation need not necessarily be an Englishman. He may be a citizen of any country. In this particular case the applicant was a German firm selling German-made machines.

The Improvement of the Columbia River.

BY DAY ALLEN WILLEY.

The Columbia River, which is the most important waterway in the western part of the United States, extends a distance of 1,400 miles from its mouth to British Columbia, where it has its source. Including its tributaries, it forms a system of waterways available for steamboats and barges aggregating 2,132 miles. This is not continuous, however, for the channel is obstructed at two different points. One of these obstructions is formed by what is called the Cascades, a series of rapids located 60 miles from the city of Portland. Here the government built, about twelve years ago, a lock canal. The canal has a depth of 8 feet and is 3,000 feet long, and it contains two locks, each of which is 462 feet in length, and capacious enough for much larger craft than pass through it to the upper river.

With the aid of the canal, steamers can travel from Portland to what are called the Dalles, a distance of about 200 miles. Here, however, the natural obstacles are very great, and to overcome them an elaborate engineering scheme is now being carried out. The river, for a distance of several miles, flows swiftly through a series of gorges which it has cut out of the rock formation in this part of Oregon. For the purpose of overcoming this obstruction, the United States engineers decided to build the Celilo canal, plans for which were approved by the Secretary of War about four years ago, along the Oregon shore, from Celilo Falls to Big Eddy on the Columbia River, the latter a formidable rapids located about four miles east of the Dalles. The proposed canal has a length of 44,880 feet, a width of 65 feet on the bottom, with locks 300 feet long. The channel of the river for the entire length of the canal is obstructed by reefs, submerged rocks, and falls, which make navigation impossible.

The building of the canal involves some heavy concrete construction. One retaining wall alone, built through the lowlands, west of the intake, will be 1,400 feet in length. The concrete side walls of the canal will in some places be 56 feet from bottom of foundation to coping, and the floor will be covered with concrete 18 inches in thickness. Practically eight miles of excavation, most of which will be in solid rock, in addition to the lock building and concrete work, remain to be done.

With the work now under way completed, continuous navigation of the Columbia will be extended from the sea to the Priest Rapids in the State of Washington on the main river. This will make a total navigable mileage in the river proper of about 400 miles; but, as already noted, the Columbia has several large tributaries, especially above the rapids referred to, and a very large area of Washington and Oregon may be reached by river craft. This area comprises not only an extensive wheat-growing country, but cattle and sheep ranches and fruit farms, as well as an extensive mining district. There are some counties in this region which are entirely destitute of railroads, and their commercial products are hauled from 50 to 75 miles to the nearest stations by freighting outfits. As the improvement referred to will allow craft carrying nearly a thousand tons to ply upon the upper Columbia, it must be regarded as one of the most important engineering projects which has yet been undertaken by the government. Engineer Mr. William G. Carroll of the United States War Department is in charge of the undertaking.

It has been decided to construct a new section of the Rhodesian Railway between Gwelo and Blinkwater, on the borders of the Victoria district. This section, which has a total distance of fifty-two miles, will tap a very rich agricultural country, and also traverse a mining district. Work on the section has already commenced, and it is expected the whole line will be finished within a year. The capital necessary for the line has been promised by the Beit trustees out of an amount left by Mr. Beit in his will for African railway construction. The new line will connect with the Cape to Cairo Railway at Bulawayo. With regard to the extension northward toward the Congo border, on the main Cape to Cairo line, negotiations are still in progress for providing the necessary capital.

Correspondence.

A SUGGESTION FOR HOUSEHOLDERS.

To the Editor of the SCIENTIFIC AMERICAN:

Often the rooms just beneath a roof are almost unbearably warm in summer. We know how refreshing a shower is. I have often lowered the temperature ten degrees in lower rooms by turning the hose so the water would play against the side of the house.

If the water pipe were extended to the highest part of the roof, and then continued—as along a ridge pole—by a pipe with a row of tiny perforations on either side, the roof could be effectively showered and cooled. Of course, in case the roof were large, the pipes would have to be brought up from below in several places, so that the distribution of the water could be controlled from below. If desirable, the water could be caught at the eaves and run into a tank or miniature standpipe, and its elevation would be sufficient to carry it over a lawn or wherever it was wanted. Or it could be guided over the eaves by a strip of galvanized iron, and so be made to run down the side of the house. Or it could be caught at the eaves and run into another perforated pipe, to cool the side of the house under the gable. MRS. F. R. MILLER.

Montreal, Can., January 18, 1909.

THE PRACTICAL SIDE OF AERIAL LOCOMOTION.

To the Editor of the SCIENTIFIC AMERICAN:

At the risk of striking a discordant note, the writer, who has long followed with interest your aeronautical notes, would like to inquire, What is the practical value of all that has so far been learned from the many experiments with balloons and flying machines? Is there any sound principle underlying any of these air vessels (by whatever name called) that is capable of development to the point of commercial success? It should be self-evident that the measure of success in aerial navigation, as in the navigation of the land and of the sea, is the availability for commercial purposes. The value of any such vessel for war purposes is merely incidental. Yet even the inventors of the heavier-than-air machines do not claim to be able to carry substantial loads over definite courses and without regard to weather conditions; and a careful study of the principles on which such machines are based gives little ground for the belief that any such result can follow the methods employed. The balloon principle, even as modified by the genius of Count Zeppelin, has so many and such well-known elements of weakness, that it need not seriously be discussed.

It has occurred to the writer that inventors are inclined to keep their eyes so closely to their own work, that they fail to grasp the full meaning of the problem to be solved; and it might not be out of place to suggest that the airship of the future—the one that will finally solve the problem of aerial navigation—will be able to rise of itself to any altitude desired, to remain in the air if need be for not merely hours but days at a time, carrying a load equivalent to the weight of five hundred passengers or more, and to descend when and where desired. With this accomplished, the problem is solved; and it can be solved by the simple application of well-recognized mechanical laws.

New York, January 12, 1909. C. A. MCCREADY.

COMPARISON OF WRIGHT AND VOISIN AEROPLANES.

To the Editor of the SCIENTIFIC AMERICAN:

In the January 9, 1909, issue of the SCIENTIFIC AMERICAN is an editorial on Mr. Lanchester's paper comparing the Wright and Voisin aeroplanes. In this comparison there is a table which states that the skin friction on the wings of the Wright aeroplane is forty pounds, quite a considerable amount, and below this the editor entertains a doubt whether Mr. Wright has been correctly quoted as saying that he makes no allowance for skin friction, believing it to be negligible. Of course, the writer is not sure whether Mr. Wright made this statement or not; but there is good proof that it is correct. Prof. Langley proved by his experiments with the resultant pressure recorder that, as he himself says, "the pressure is normal to the inclined surface, and hence that the effects of skin friction, viscosity, and the like are negligible in such experiments." Prof. Langley's statements are all so exact and trustworthy, that we can hardly doubt this one. Also Mr. R. H. Thurston, in the Universal Encyclopedia, says that Mr. Maxim found the resistance due to friction of the surfaces of a plane was imperceptible, and might be neglected. Both of these results contradict the statement that there should be forty pounds of resistance due to skin friction in the Wright aeroplane, and uphold Mr. Wright's statement that this friction is negligible.

Farther on in the article Wilbur Wright is quoted as saying that "as far as the Wright aeroplane is concerned, stability depends entirely on the skill of the aeronaut"; and Mr. Lanchester compares this with the stable equilibrium of the Voisin aeroplane, both lateral and horizontal. The writer believes that Mr. Wright's statement refers only to the lateral stability, for evidently, with the tips of the wings turned down, his machine would quickly tip sideways if no aeronaut were guiding it, and thus the stability does entirely depend on the skill of the aeronaut, although, as the editor has well pointed out, when an aeronaut is in the machine, its stability is much surer than that of the Voisin type. Mr. Lanchester says, "The pressure is less per square foot on the tail (of the Voisin machine) than on the main aerofoil, so that the attitude of the aerodrome to its line of flight is one of stable equilibrium." In the Wright machine, however, the center of gravity is in front of the normal center of air pressure, and the front rudder is always turned upward at a slight angle, so that the attitude of this aerodrome to its line of flight is also one of stable equilibrium, and can be much more surely guided vertically than the fixed-tailed Voisin type. Moreover, it fulfills Mr. Lanchester's second condition of stability, in that the areas and disposition of the surfaces, the amount of inertia, the velocity of flight, and the natural gliding angle are related to comply as well with the equation of stability as that of the Voisin machine, so that any oscillation in the vertical plane of flight does not tend to any increase in amplitude.

ARTHUR HOLLY COMPTON.

Wooster, Ohio, January 19, 1909.

MORE CURIOUS FACTS ABOUT NUMBERS.

To the Editor of the SCIENTIFIC AMERICAN:

Mr. Springer's articles on "Curious Facts About Numbers" have been interesting me much. Though not a profound mathematician, like Mr. Springer, I have given some attention to arithmetic, and among other work I was fortunate enough to hit upon a general method of forming right-angled triangles, in whole numbers, and have often tested its usefulness in teaching junior arithmetic and mensuration.

1. My first formula was $\frac{n^2}{2} \pm \frac{1}{2}$, which gives a right-angled triangle, with n $\left(\frac{n}{2} + \frac{1}{2}\right)$ and $\left(\frac{n}{2} - \frac{1}{2}\right)$ as sides.

Thus $3^2 = 9$ and $\frac{9}{2} \pm \frac{1}{2} = 4$ and 5. Again, $5^2 = 25$ and $\frac{25}{2} \pm \frac{1}{2} = 12$ and 13. And $7^2 = 49$ and $\frac{49}{2} \pm \frac{1}{2} = 24$ and 25.

It is easy to continue this series, which gives a right-angled triangle, in whole numbers with every odd number as the short side, the difference of the two longer sides being always 1: 3 gives 3, 4, 5; 5 gives 5, 12, 13; 7 gives 7, 24, 25; 9 gives 9, 40, 41; 11 gives 11, 60, 61; 13 gives 13, 64, 65; etc.

2. My next formula is $n, \frac{n^2}{4} \pm 1$ or $\frac{n^2}{4} + 1$ and $\frac{n^2}{4} - 1$, for even numbers only.

Thus 4 gives $\frac{16}{4} \pm 1$ or 4, 5, and 3.

6 gives $\frac{36}{4} \pm 1$ making 6, 8, and 10.

8 gives $\frac{64}{4} \pm 1$ producing 8, 15, 17.

12 gives $\frac{144}{4} \pm 1$ producing 12, 35, 37.

16 gives $\frac{256}{4} \pm 1$ producing 16, 63, 65.

20 gives $\frac{400}{4} \pm 1$ producing 20, 99, 101.

Some of these results are multiples of those produced by the first formula, but the difference between the two longer sides is always 2.

3. Another formula of the same series gives n with $\frac{n^2}{8} + 2$ and $\frac{n^2}{8} \pm 2$ as three sides, n being divisible by 4, and the two longer sides having a difference of 2. But these sets frequently turn out to be multiples of sets already found, because any multiple of 4 contains the factor 16, when squared, and hence $\frac{n^2}{8} \pm 2$ gives numbers always divisible by 2, and thus the three numbers are often capable of division by 2 or some multiple of 2.

4. Let n be any odd number, and s the number of formula in the series, and we get the general formula for any number of the series:

$$\frac{(2^s - 1n)^2}{2^s} \pm 2^{s-1}$$

Victoria, B. C. J. G. HANDS, M.D.

THE AURORA BOREALIS AND MOREHOUSE'S COMET.

To the Editor of the SCIENTIFIC AMERICAN:

Prof. S. A. Mitchell's article on the peculiar behavior of Morehouse's comet is very interesting. We might well hope that a study of this comet will give us a much more definite and comprehensive conception of the significance of cometary and allied phenomena. Apparently the greatest change occurred during the night of September 30. Now it was on the evening of September 29 that there occurred such a display of the aurora borealis that you have but to inquire of any man in the northern part of the United States (who happened to be outdoors that evening) from Maine to Washington, to be assured of its wonderful activity, and to realize that it is very rarely that we witness displays that can compare with this.

In a letter from Mr. Sidgraves (Stonyhurst College Observatory) which appeared in Nature October 29, he tells of a magnetic disturbance which coincides in time with this aurora. It seems to be universally granted that the aurora and magnetic disturbances are closely related, also that both may be referred to solar influence. Mr. Sidgraves has shown that the coincidence in the time of happening of the aurora and magnetic disturbance was almost exact. It seems that the violent change in the comet and the terrestrial maanifestations can also be made to coincide in time of happening after suitable deductions have been made, and therefore prove that they were acting under the same influence. Now it was suspected a long time ago that there was a strong affinity between the aurora and comet's tails; this is a unique opportunity for confirming that suspicion.

It has been claimed that there is an 11-hour interval between a solar disturbance and the terrestrial response. Now, then, the distance of the Morehouse comet from the sun on September 30 was about 1.7 times the distance of the earth from the sun. Applying this correction, we should expect to see the comet responding about thirty hours after the same influence had reached the earth.

As near as I can ascertain from the available data, this is precisely what happened. It is almost half a century since Proctor prophetically said that "as surely as the brilliant planets which deck the nocturnal skies are illuminated by the same orb which gives us our days and seasons, so are they subject to the same mysterious influence which causes the northern banners to wave resplendently over the star-lit depths of heaven. Nay, it is even probable that every flicker and coruscation of our auroral displays corresponds with similar manifestations upon every planet which travels around the sun." There is very little doubt of this to-day. What remains is the greater problem, namely, its physical interpretation.

Prof. Mitchell has made an inevitable comparison between Morehouse's comet and Daniel's comet of 1907. Daniel's comet was an "orderly, well-behaved body," while Prof. Barnard regards the Morehouse comet as "the most startling comet since the application of the sensitive photographic plate." There is something else about these two comets in which they differ as widely as possible.

The orbit of Daniel's comet is approximately in the plane of the sun's equator, while the orbit of Morehouse's comet is at right angles to the sun's equator.

Their difference in behavior is just what we should expect from our knowledge of solar activity. It is well known that solar activity varies with the solar latitude; therefore any body that revolved around the sun at right angles to the sun's equator would necessarily experience all the possible range of solar influence that can be ascribed to latitude. It would seem that the influence due to the inclination of a comet's orbit upon the comet is anything other than unimportant.

An examination of all the apparitions of which we possess an adequate record may result in a classification that would help to solve the riddle of the comet.

WILFRID GRIFFIN.

Pittsfield, Mass., January 14, 1909.

MAGNETISM AND THE AURORA.

To the Editor of the SCIENTIFIC AMERICAN:

I take the liberty of presenting for the consideration of your readers some suggestions which seem to me to afford material upon which to found new hypotheses explanatory of the causes of the magnetic streams of the earth, of the aurora, and of the observed coincidence between magnetic and auroral disturbances and the occurrence of sunspots.

If we suppose the earth with its content of iron to be an armature cutting in its rotation the field of force projected from the sun, do we not suggest a valid explanation of the magnetic streams of the earth, which flow from pole to pole, and in the current of which lies the magnetic needle like a ship moored in running water?

Is it not, therefore, a fair inference that the earth, being magnetically energized by its rotation in the field of the sun, projects from one pole, to be received at the other, a stream of one or more of energy's interconvertible forms? The pattern assumed by iron filings sprinkled upon a sheet of paper laid upon a bar magnet suggests the possible direction of the paths taken by this stream.

Is it not fair, also, to assume that the branches of this stream, which radiate from one pole and seem to converge upon the other, in their passage through the rarefied gases of the upper atmosphere, produce the aurora—perhaps by the kind of action suggested by Arrhenius in his theory of the pressure of light?

If the magnetic currents of the earth depend upon the earth's rotation in the sun's field of force, it is permissible to believe that any variation of the intensity of the force of that field must instantly result in a corresponding variation of intensity in the earth's magnetic currents. Such a change might exhibit itself as a change of direction as well as of intensity, owing to the change in the established relationship existing between the earth's currents and the earth's diversely located magnetic content which a change of the intensity of those currents would entail.

Assuming therefore that a change of the intensity of the sun's field entails a corresponding alteration of the intensity (and perhaps direction) of the earth's currents, it follows that their polar off-world streams would likewise be varied in intensity. This being so, the visible expression of these streams, found in the aurora, should vary, and the visibility of the aurora be altered thereby.

It has been observed that during the occurrence of sunspots there are marked magnetic and auroral disturbances upon the earth. The line of reasoning thus far pursued would suggest that at such times there is a correspondingly violent alteration of the intensity of the sun's field in which we rotate. Is it of greater, or of less intensity?

If it be greater, the earth's currents and their various expressions should be of greater intensity; if it be less, they should be correspondingly of less intensity. But should a lessening of intensity in the earth's currents involve only such a change as is without violence in its expressions? Not necessarily; for a curtailment of the received supply of the sun's energy would seem as likely to upset the earth's magnetic equilibrium as would an accession of energy, while in either case violent forms of expression conceivably could result.

Nor is the fact that an amplified auroral display during the existence of sunspots seems to indicate that the play of forces is then of greater intensity, conclusive that such is the case. For it is conceivable that a lesser stream pressure than is normally maintained might be better adapted to render visible the atoms of the rarefied atmospheric gases which, when played upon by the polar streams, become the aurora borealis.

The writer is inclined to believe that a sunspot diminishes the intensity of the sun's field of force, because it lessens the amount of what seems to be its area of greatest activity to which the earth is exposed.

Other phenomena, such as the gradual shift of the magnetic poles and diurnal magnetic variations, may be explained, the writer believes, by hypotheses in harmony with the foregoing.

HENRY A. WISE WOOD.

New York, January 30, 1909.

NOVEL LIFE-SAVING APPARATUS.

BY OUR ENGLISH CORRESPONDENT.

Experiments have been carried out in the port of Hamburg with a novel apparatus devised by a German inventor for rescuing sailors who have fallen overboard. The results have proved so completely satisfactory that it has since been adopted by the German Admiralty, and arrangements are now being completed by which every naval vessel will be equipped with one or more of these appliances. The apparatus, as may be seen from the accompanying illustration, is of a very simple character, comprising a cylindrical cage, built up of rope ladders disposed around the periphery of the circular framework. There are in all six of these ladders anchored top and bottom to iron hoops and with a supporting hoop midway between the end pieces. When extended in the manner shown, the cage is about 13 feet in height by some 4 feet in diameter.

The floor of the cage is built up of rope netting of fairly close mesh, to afford an easy foothold, while at the top the rope side members of the ladder are continued to form a cone terminating in an iron ring, by means of which the whole apparatus may be slung from a hook working with a block and tackle. When not in use the whole folds up into a small space, collapsing much after the same manner as a Chinese lantern, so that it can be stowed away in any convenient spot.

In the case of an accident, such as the capsizing of a pinnace or a sailor falling overboard, a davit or spar carrying a block and tackle is run out over the ship's side and the pulley rope made fast to the top of the cage, which is then thrown toward the scene of the accident. The act of throwing causes the cage to distend to its fullest extent, so that the man in the water can grasp either a rung of one of the ladders or climb to a position above the water on the outside of the cage, the hoisting tackle being manipulated so as to keep a sufficient length of the cage well above the water, so that the rescued man can secure a safe position. The advantage of the apparatus is, that it can be used for saving a number of men simultaneously with the least trouble, being simply thrown in their midst, when it is easily grasped by all, so that the risk of drowning is minimized. Even in the event of one or more of the immersed men being non-swimmers, risk of drowning is reduced, since the appliance can easily be hauled toward the helpless by one who is a swimmer, or trained toward the spot by means of the spar tackle to which it is attached. For use in tropical waters, where the seas are infested by marine foes, it is especially useful, since there is sufficient space between the ladders to allow rescued persons to make their way into the interior of the cage. This done, the cage with its human freight is simply hauled up out of the water by the block and tackle, swung round, and safely deposited upon the deck.

It will thus be seen that the device is very simple, both in design and operation, and that it dispenses with all preliminaries. Upon large warships it can be stowed, with the hoisting rope attached, in various out-of-the-way places on the upper deck, ready for instant casting overboard by hand. The rope can be attached to the spar block and pulley tackle while the drowning are grasping the appliance, and the device immediately hoisted and swung inboard. The central hoop not only prevents the rope ladders from bulging or becoming entangled, so that when thrown out the cage expands immediately, but it is also useful for the attachment of a steadying line held from the deck during the hoisting and hauling-in operations.

ROAD BUILDING BY THE UNITED STATES IN CUBA.

BY WILLIAM ATHERTON DU PUY.

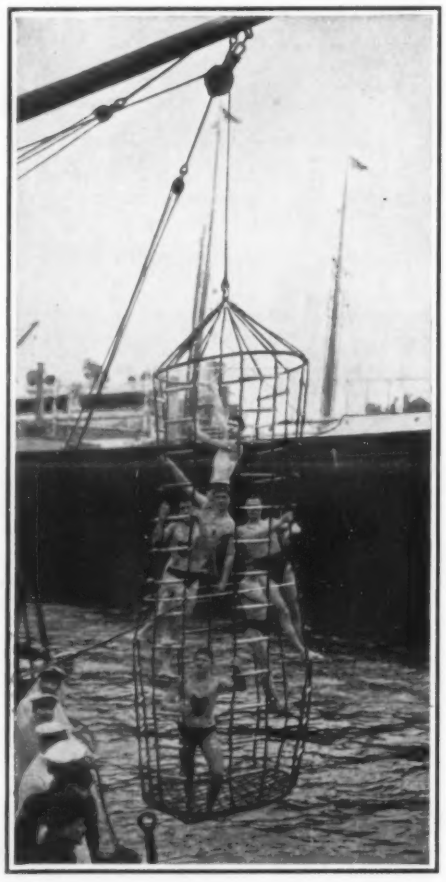
Were the people of the six provinces of the island of Cuba to lay about them in search of a fitting memorial to be erected to the provisional government so recently brought to an end in that West Indian republic, they might go far and fare worse than in carving a traction train in bas-relief around a concrete pedestal bearing a road roller rampant.

This because of the fact that one of the greatest accomplishments of the *régime* of the provisional governor, Charles E. Magoon, representing the United States, has been the opening up of the island from end to end, and in a dozen places from coast to coast laterally, with excellent macadamized roads built on the most approved modern principles. Some of these roads follow the course of old ones that had been graded in a desultory way by preceding Spanish and Cuban administrations; but for the most part they replace cart-cut tracks through the thickets, that were barely passable in dry weather and entirely useless during the long rainy season. They replace the pack-train of donkeys with the automobile, and bring easy communication to the fertile acres of the entire country, much of which has been hitherto completely isolated. They open up the arteries of trade to sections that for hundreds of years have stagnated for a lack of ability to get their produce to market.

When Governor Magoon went to Cuba and began looking about to find in what manner he might permanently benefit the people and lift them from the deplorable financial condition in which he found the mass of them, he immediately hit upon the matter of roads. He argued that the island could not prosper unless it were given an opportunity to get to market its tobacco, sugar, and fruits.

Despite the poverty of the people, he found that there was money in the treasury of the government; for the revenue sources of the nation yielded funds plentifully. There was, in fact, $13,000,000 in the treasury, and its disbursement for the greatest benefit of the quasi-republic was placed in the hands of the governor. His decision was for roads, and there was a short shift before he got actively to work.

The old roads had come into being when the pack trains followed the winding trails of the cattle; and the carts eventually followed these. In laying them out there was no disposition to follow the shortest line between two points. There were no bridges over the streams, and the freshets constantly washed out the palm trees that the natives threw into the river beds to make a crossing possible. For a considerable part of the year no wheel could pass these roads and pack trains floundered through mud holes up to the stirrups. All gayly caparisoned, the animals burdened with foolish saddles that were a load in themselves, and led by the "bell jack," these pack trains often became pitiable spectacles before the journey's end was reached.



HOISTING AND SWINGING LIFE-SAVING CAGE TO SHIP'S DECK.

The Cubans also use a most unserviceable cart called a *carreta*—a large, clumsy, two-wheeled affair capable of bearing a heavy load. Its chief drawback is its tire, which is particularly narrow, and cuts deep into the muddy road. The wheel is set loose on the axle, and when the driver finds himself stuck, he rocks the affair back and forth until the wheels by their motion have dug themselves out, when he drives on, leaving the trap he has made for the benefit of the next traveler. From two to ten oxen are used on these carts to pull a load that should be readily handled by two mules; and days are taken to make trips that should be accomplished in hours.

The provisional governor realized the unusual difficulty of building permanent roads in Cuba, where the rains are torrential and the wet season lasts from May to November and the dry season from November to May. The conditions demanded that if the road was to last it must be above all a good road. The roads were laid out approximately as the crow flies, from Santiago de Cuba at the extreme east end of the island to Los Arroyos de Mantua in the west. At frequent intervals spurs were run to the coast towns on either side; and the whole was brought into one articulated system. The roads were graded in such a way that nowhere was the incline more than 6 per cent. The site was first plowed and leveled with an easy crown to the center. On top of this surface was placed six inches of rock in pieces as big as a man's two fists. Above this came four inches of broken stone the size of an egg, and then a final covering of fine surfacing stone, which filled all the voids. The road was then compacted by a heavy steam roller.

The cream and blue limestone of the country furnished the material for the roads. The roads are of a universal width of 34 feet, of which the pavement covers 16 feet. All the culverts are made of concrete. The bridges are modern steel structures such as the island never saw before. The right-of-way was ditched to prevent inundation, and swamps were drained where they interfered with the work. At intervals of fifteen miles there is a road house, at which is stationed a caretaker and the employees who maintain the road. Here also are being grown the trees that are to be set out all along the roadway; and which in this climate will in a few years convert it into an arch of dense, green-topped shade.

The work of the roads coming as it did at an opportune time, had a remarkable influence upon the people. They were in desperate financial straits and were threatened by all sorts of civil warfare. In the west, for instance, the latest of the revolutions, "The Little War," had broken out in August, 1906. The progress of hostilities in this section attracted to it the floating population which is ever looking for trouble. Just then work on the government road at good wages was offered, and friend and foe went to work side by side and hostilities were forgotten.

For two years the work of road building went forward unceasingly and the steady employment and the steadily added opportunity to market produce began to make themselves felt. From the weird valleys of Cabezas, Simidero, Luis Lazo, and San Carlos, the homes of the mythical *mogotes*, from which comes the cream of the Vuelta Abajo tobacco, there is to be heard the song of prosperity. In the Mantezuelo valley, where grows the yellow tobacco leaf, so highly prized as wrappers, and which furnishes the Havana tobacco most used in the United States, the fertile lands are giving an ever-increasing yield of their choice product. The Ocean Beach tract, owned by Canadians, is supplying such fruit for export as it never produced before; and in Pinar del Rio the fields of sugar cane wave unmolested and the five great mills grind without cessation. Everywhere new life has been given to the country, and it has largely come about through the roads which are an asset that even revolution may find itself unable to destroy.

The construction of these excellent roads has made Cuba particularly attractive to automobilists and particularly to those of the United States who wish to follow the pastime during the winter months. A typical highway is to be found in one of the cross roads that leads from Pinar del Rio through the far-famed Viñales Valley to the seaside at Esperanza.

The road winds through rich fields of tobacco dressed in vivid green, and passes patches of yucca, malanga, and sweet potatoes. By the side of the streams and under the shade of the mango and aguacate trees are the huts of the natives with naked brown children running about, and lustrous-eyed *señoritas* flirting with the task of keeping house. Higher up, the hills grow more precipitous, and one marvels at the steep cliffs upon which are clinging the native huts, and at the patches of cultivated land, access to which can be had only by climbing ladders. But this is the particular soil which gives to tobacco that quality so highly prized by connoisseurs, and it is worth the many inconveniences of access and residence involved in its cultivation.

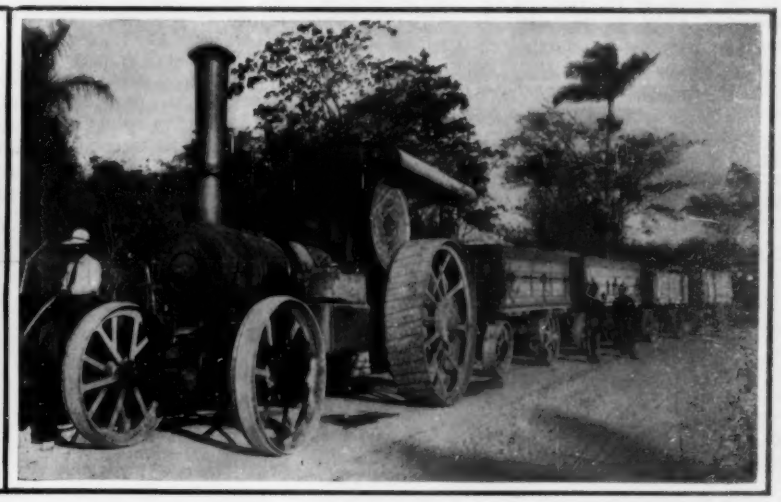
The wonderland, however, lies beyond the crest of the divide, and beyond the bloody field of the Battle of the Guias from which blood trickled into the clear streams below in 1896. For, around a sudden bend, one drives abruptly into the Valley of Viñales, nestling among those peculiar monolithic mountains that the natives term *mogotes*, and which the geologists declare to be unequaled in their class the world over.

The *mogotes* are huge limestone pillars, hundreds of feet in height, which stand sentinel-like on the plain, solitary, isolated and seemingly altogether out of place in such a gentle landscape. Strange tales are told among the natives of the mythical origin of these columns; but the scientist tells a story that is little less strange in its import. He says that once, in the long ago, there was a huge cave in what is now this valley, within which great stalactites and stalagmites were formed, which, uniting in the course of ages, formed massive pillars that supported the roof of the cave. As the ages passed the surface was eroded and finally the roof fell in. Passing time wore away the soil, the hills disintegrated, and the general level was greatly reduced. But the pillars were made of sterner stuff and have remained.

In the valley itself the *veguero*, as the tobacco grower is called, has cultivated his field in patchwork fashion. His thatched hut stands in crannies under the cliffs or, again, bravely out in the open, a dot in the plowed ground. Roads and bridle paths line the level surface of the valley. The place looks like a child's sand map, decorated with stiffly straight trees.

The Old Way.

The Cuban driver is not alarmed at the predicament of his cart here pictured, which is mired within reach of the new road soon coming to his rescue via the big bridge just up.



A traction train on an American-built road.

The present provisional administration inaugurated, in the spring of 1907, the present plan of improvements, making use of previous studies and modifying them to meet modern requirements.

A typical bit of old road, worn wagon-deep.

View on the route of the new Luis Lazo-Guane highway, at a point twelve miles from Guane, near the Macurijes River. To the right are typical huts of tobacco growers.

On the Pinar del Rio-Viñales-San Cayetano-Esperanza road.

Limestone cliffs flanking the hills of San Vicente. This is tobacco country; not genuine Vuelta Abajo, but semi-vuelta; so good that few save most discriminating smokers detect the difference.

Between kilometer posts 10 and 18 on the Pinar del Rio-Luis Lazo road.

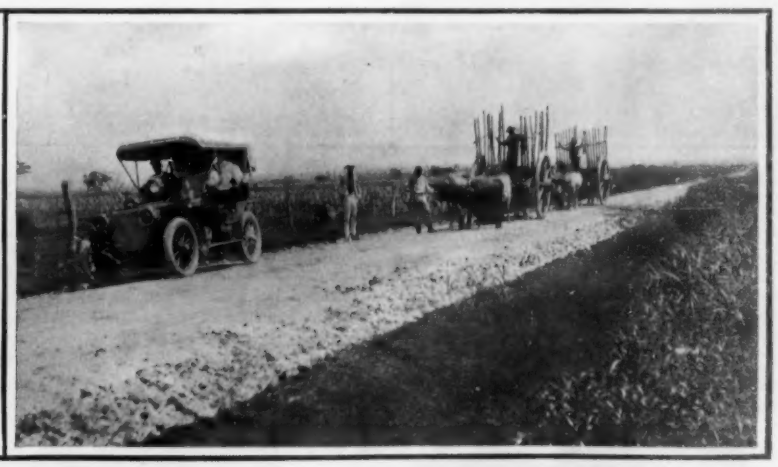
A deep cut. Crossing the hills between Pinar del Cerro by a road whose grade does not exceed six per cent.

Cut and fill between kilometers 10 and 18, Pinar del Rio-Luis Lazo road.

Note the fertile patches of cultivated land in the bottoms. The old means of transport was by pack train. Even the bullock carts abandoned the roads.

On the Pinar del Rio-Viñales-San Cayetano-Esperanza road.

The road here lies in the level country between the Organos and the north coast.



The Duran Road across flat lands approaching Batabano.

The old makes way for the new—the ox cart for the touring car. Cane fields on either side.

ROAD BUILDING BY THE UNITED STATES IN CUBA.

In the midst of the valley is the town of Vañales, red-roofed, white-pillared, and incredibly clean and prosperous. It has its church and its barren square; its wide streets cross at right angles. Beyond the town the road leads on through La Abra (the gap) a narrow gateway opening into a smaller vale similar in its characteristics, and so on to the sea, a wonderland of quaint and queer arrangement of man and nature. This valley is typical of the fair land that the United States has brought into peace, serenity, prosperity.

PHOTOGRAPHING ANIMALS UNDER WATER.*

BY PROF. JACOB REIGHARD, UNIVERSITY OF MICHIGAN.

Attempts to photograph submerged objects with a camera placed in air can result in only partial success, and this but rarely. Failure is due to the fact that the photograph is made through the surface of contact of two media, water and air, of very different refractive powers. If this surface is not perfectly smooth the light from an object beneath it is, upon emergence, refracted unequally at different parts of the surface and can not form a clear image on the ground glass. Whether the water is smooth or rough its surface reflects a part of the light which strikes it, and thus acts as a mirror. This reflected light makes it impossible, except under unusual conditions, to obtain photographs of submerged objects. To obtain such photographs the surface of the water must be smooth and light reflected from it must not enter the camera.

If the camera with which submerged objects are to be photographed is to remain above the surface of the water means must be found (1) greatly to reduce the amount of reflected light entering the camera from the surface of the water, and (2) to render the surface of the water smooth. We may consider first the case in which the surface of the water is smooth, so that it is necessary merely to minimize surface reflection.

The method to be described is best adapted to objects in water not more than two or three feet deep, and the best results are obtained when the water is less than a foot in depth and when the camera is one that can be focused. Since the objects to be photographed are usually in motion, and since the surface of the water may at any time be roughened by a puff of wind, it is best to use a lens of a speed not less than *f* 8. The operator should first select the point from which the picture is to be taken. He should, of course, have the sun at his back or to one side. If possible he should stand on the bank or on some fixed support which extends above the surface of the water.

If the operator is unable to find a fixed emergent support he may make the exposure while standing in the water. The camera may then be held in the hand or may be supported on a tripod which rests on the bottom. As the legs of the tripod are likely to sink into the bottom they should be extended to their full length. Where the bottom is firm an elevated position may be obtained for the camera by using a tripod with legs some 10 feet long, such as dealers sell for use in making pictures of large groups. In such tripods one leg forms a ladder by which the camera may be reached.†

When the operator has placed his camera and roughly adjusted it, he should set up a screen to cut off the light reflected from the surface of the water into the camera. Any piece of dark fabric, a blanket, shawl, or for small objects even a coat, may be used.

The screen is mirrored in the surface of the water. The object to be photographed should fall within the limits of this mirrored image as seen from the camera. If it does not, the screen or the camera must be shifted until it does. The operator will see also the shadow of the screen. This should *not* fall on the object to be photographed. The screen should, if possible, be adjusted by slanting it or by moving one of the poles so that the sun strikes it nearly edgewise, but yet does not strike that face of it which is toward the camera. If this adjustment is properly made the shadow of the screen is a very narrow band, which lies beneath the screen and a little nearer the camera than its lower edge. The full sunlight then falls on the object while the rays from distant objects which would otherwise be reflected into the camera from the surface of the water are cut off. If the sunlight is permitted to fall on that face of the screen which is toward the camera, it is reflected from the screen to the surface of the water and thence into the camera. A picture taken under these conditions may show, besides the object under the water, also the screen itself, although this image of the screen is usually so faint that it does not interfere with the use of the picture for scientific purposes.

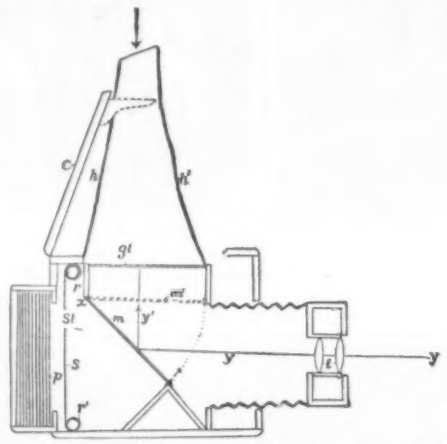


Fig. 8.—A reflecting camera shown in section with magazine plate holder attached.

gl, Ground glass; *h*, *h'*, hood; *l*, lens; *m*, mirror in position during focusing; *m'*, mirror, showing position during exposure; *p*, sensitive plate; *r* and *r'*, rollers of focal plane shutter; *s*, the shutter; *st*, slot in shutter; *x*, hinge on which mirror turns; *y*, *y*, *y'*, ray of light traversing the lens and reflected from the mirror to the ground glass.

When the screen has been properly set the operator has merely to adjust the camera and make the exposure in the customary way. If the subjects are fish they will usually have been frightened away, but if the fish are engaged in nest building or in some other occupation that attracts them to a particular spot, they will, in most cases, return after a time varying from five minutes to an hour. The operator has merely to remain quiet until this happens. The photographer may focus his camera on the spot to which the fish is likely to return and then withdraw and operate the camera from a distance by pulling a string or pressing a bulb when the fish returns. The method is of most use in securing photographs of the nests and habitats of fish in shallow water, yet the writer has succeeded by means of it in making some satisfactory photographs of fish on the nest.

If the surface of the water is not smooth it may be made so by a water glass, which may be constructed as follows: A square frame is made of heavy galvanized iron, and measures 3½ inches deep and 12 inches on each side within. One of its edges (the top) is turned outward three-fourths of an inch and then downward one-half inch to form a lip. This stiffens the frame and tends to prevent water from slopping into it. The lower edge of the frame is turned outward about half an inch to form a flat surface, against which the glass, 13 inches square, is bedded in aquarium cement. After the glass is in position four trough-shaped pieces are soldered to the sides of the frame and to one another in the manner shown in the figure. The free edges of these pieces project inward beneath the lower surface of the glass and support it. Before the pieces are soldered into place cement is placed between them and the lower face of the glass. The whole border of the glass is thus bedded in cement on both surfaces and at the edge. To protect the glass when not in use a flat cover is provided, which fits against its lower face. Such a water glass may be floated over the object to be photographed and a screen set up independently of it, or the screen may be attached to the glass itself. For the latter purpose a piece of half-inch band iron may be bent to form the three sides of a rectangle, 8 by 12 inches, and this may be riveted as a bail (Fig. 7) to the inside of the frame, about 8 inches from one side. The bail should turn on the rivets so that it may be depressed into the frame when not in use. A screen may be formed by raising the bail and tying a piece of black cloth from it to the opposite side of the frame. In shallow, running water it is desirable to support the water glass from the bottom in order that it may not sink so much as to displace or distort the object to be photographed. It may be supported on four iron rods which run through metal sleeves soldered to the four corners of the frame. The rods may be fixed in any position in the sleeves by means of set screws, and may project upward far enough to support the upper edge of the screen.

The writer has used water glasses of this type varying in size from 1 to 3 feet square. The size most suitable for field photography is 2 feet square, since this may be transported by hand.

The method described is suited only to shallow water, where the camera may be supported from a firm substratum. In deeper water the unsteadiness of the boat would interfere with the manipulation of a water glass or a screen. It might be possible, however, to construct a boat of which the water glass and the screen should form constituent parts. The method described permits only of views at angles of from about 48 deg. to 90 deg. to the water's surface. Since it is not practicable to place the camera far above the water at these angles or to use screens of very large size, the pictures that may be taken are of near objects and the field covered by them is of limited extent. If a water glass is used, the camera must be near it and the field is limited by its frame. The method is, however, the only one known to the writer for certain kinds of work.

A camera for submerged use made after the ordinary type must be securely closed before submerging it in order to protect the lens and the plates from the action of the water. While the camera is under water it is not possible to remove the plates or plate holder in order to substitute a ground glass for them. In subaquatic photography the objects to be photographed are all near, and if instantaneous work is to be done the lens must be very rapid. It is therefore important to be able to focus accurately on the ground glass under water, and this might be accomplished by using two identical cameras (twin camera) united so as to form one instrument. One of these contains the plates and has a lens provided with a shutter. The other camera carries the ground glass. The same focusing mechanism operates both cameras, so that when a sharp image is formed on the ground glass of the one an identical image strikes the sensitive plate in the other when the shutter is operated. One of the cameras serves merely as a focusing finder of full size. A camera of this type properly constructed of metal could undoubtedly be used successfully under water, though it has the disadvantage of being unnecessarily cumbersome and expensive.

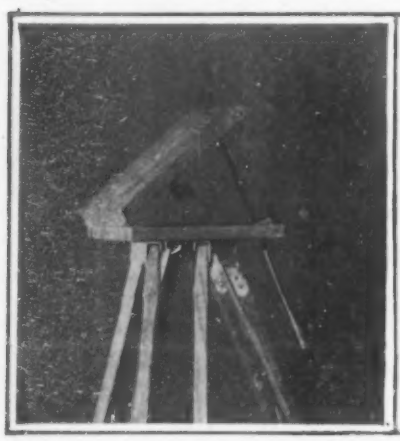


Fig. 5.—Tripod top by means of which the camera can be inclined at any angle.

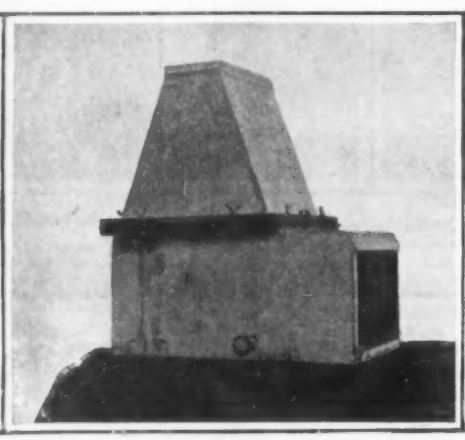


Fig. 6.—Watertight box to contain submerged camera.

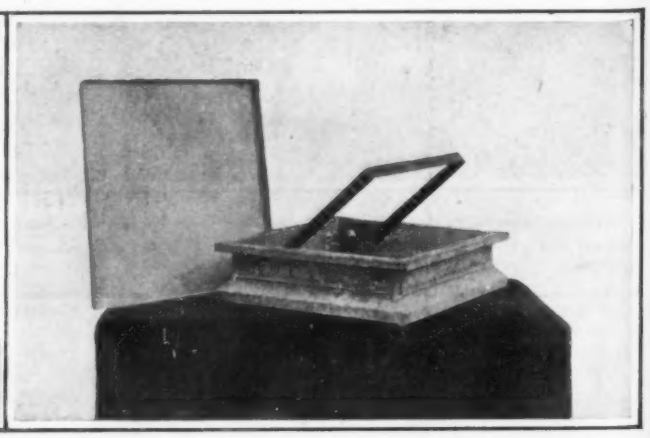


Fig. 7.—Reighard water glass for observation or photography of objects under water.

PHOTOGRAPHING ANIMALS UNDER WATER.

* Abstracted from "The Photography of Aquatic Animals in Their Natural Environment," a bulletin published by the Bureau of Fisheries. The complete bulletin will appear shortly in the SCIENTIFIC AMERICAN SUPPLEMENT.

† A detailed description of the construction of the tripod top will be found in the original.

All of the advantages of the twin camera are to be had by using a reflecting camera, which is at the same time both lighter and less expensive. The principle of the reflecting camera is shown in the diagram (Fig. 8), which represents diagrammatically such a camera in longitudinal section. The operator, holding the camera in front of him, looks in the direction indicated by the upper arrow, at the ground glass through the hood, which takes the place of a focusing cloth. The interior of the camera contains a mirror (*m*), which extends from beneath the back edge of the ground glass downward and forward at an angle of 45 deg. The mirror is hinged at *x* to the top of the camera. When it is in the position shown at *m* in the figure the space between the back of the mirror and the back of the camera is quite dark. Light entering through the lens is reflected by the mirror and strikes the ground glass, as shown by the line *y y y'*. The image as seen on the ground glass by the operator looking down through the hood is, on account of the action of the mirror, an erect image, not an inverted image such as one sees on the ground glass in the back of an ordinary camera. It is also an image of the full size permitted by the plate and the lens, not a reduced image such as one sees in a finder. The shutter (*s*) is a focal plane shutter situated at the back of the camera just in front of the plate (*p*). Such a shutter is essentially a roller curtain of black cloth with a slot (*sl*) across it at one point. The width of the slot may be regulated. The shutter is wound upon an upper roller (*r*) until the slot is upon the roller. The exposure is made by causing the curtain to unwind from the upper roller (*r*) and wind upon the lower roller (*r'*) so that the slot passes with great rapidity across the face of the plate.

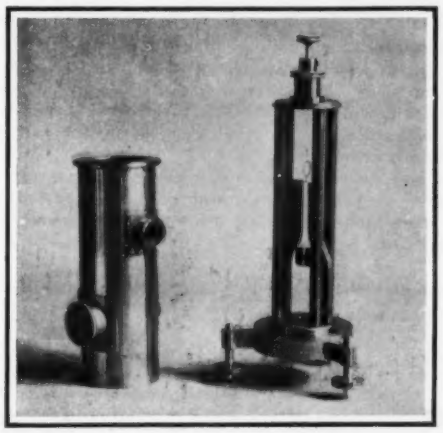
The length of the exposure depends on the width of the slot and the rate at which it moves. The rate may be varied by changing the tension of the spring which actuates the lower roller. The operator holds the camera in front of him with both hands while he looks down at the ground glass through the opening in the hood. With one hand he focuses. When the object appears in sharp focus and in the desired position on the ground glass, he presses a button with the other hand. This causes the mirror to swing on its hinge to the position shown by the dotted outline *m'* beneath the ground glass. In this position the mirror excludes light which might otherwise enter the camera through the ground glass. At the same time the change in position of the mirror permits the light, which was before reflected to the ground glass, to fall upon the plate. The adjustment is such that an image which is in sharp focus on the ground glass will be in sharp focus on the plate when the mirror changes position. The image does not actually strike the plate so long as the shutter is wound upon either roller. Before the instrument is to be used the shutter is wound on the upper roller. When the mirror in swinging upward reaches the position *m'* the shutter is released from the upper roller and taken up on the lower roller. As the slot of the shutter curtain passes across the plate from above downward, the image falls through the slot onto the plate in successive strips corresponding to the width of the slot.

A 5x7 camera of the type just described, with a magazine holder for twelve plates, was used by the writer to obtain submarine photographs at Tortugas, Fla., during the season of 1907.

The apparatus was carried to a boat or, if it was to be operated near shore, to the shore. In working with the help of a boat the operator wades on or near the coral reef with his head and shoulders above the water. The boat, with an attendant on board, is anchored near. The operator, with the help of a water glass, now seeks a favorable place for operations. As he moves about the reef, the fish at first seek shelter in the dark recesses of the coral rock, but if he selects a favorable place and remains quiet they soon reappear. They are at first wary, but soon grow bolder and after half an hour or so pay but little attention to him. There is a great difference in wariness among different species of fish. At first only one or two species appear, demoiselles and slippery-dicks usually, then the number of species gradually increases until the shyest butterfly-fish and parrots come within 6 or 8 feet of the operator. He then has the camera passed to him from the boat. It floats with the upper part of the hood protruding and may be easily turned toward any point on the horizon or even tilted so as to be pointed at a considerable angle upward or downward. The operator has now merely to direct the camera at the fish, while he focuses with his right hand. He must often wait some time before the fish come to the point selected or assume the desired attitude. Often they may be enticed by throwing in a bait of crushed sea urchins or pieces of crawfish. They are in constant motion, so that he must as constantly focus. He often misses a long-awaited opportunity because the fish moves on or takes a wrong attitude before he has had time to focus sharply; but when the favorable time comes he presses the release stem and the exposure is made.

A NEW DIRECT-READING PHOTOMETER.

Lamps of all kinds transform heat into light, the apparent intensity of which varies with the character of the incandescent body which emits it, and is also a yet unknown function of the photo-chemical transformations which are produced in the retina. In our ignorance of these transformations we can only measure the luminous power of a lamp in terms of standard candles or other arbitrary units. Numerous at-



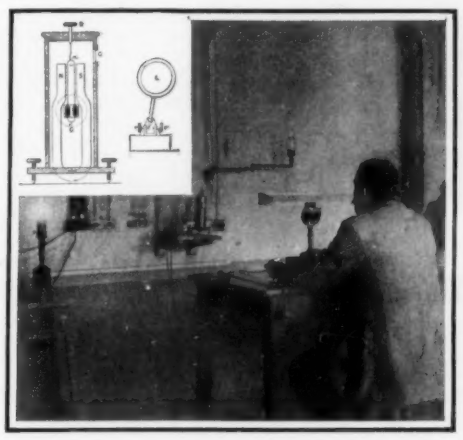
Féry photometer, with copper cylinder removed.

tempts have been made to effect these photometric comparisons without the aid of the eye, but it has hitherto been found impossible to construct an apparatus having the same comparative sensitiveness to the various regions of the spectrum that is possessed by the retina. This fact explains the failure of methods based, for example, on photography and on the effect of light on the electrical resistance of selenium.

No better result has been obtained by measuring the total energy of the radiation emitted by sources of light, for the maximum of this energy usually falls in a part of the spectrum to which the eye is absolutely insensitive. Prof. Charles Féry, of the Paris School of Applied Physics and Chemistry, has demonstrated that, in order to obtain correct results by this method, the measurement should be made on light which contains the various elementary radiations in quantities proportional to their effects on the retina.

Upon this principle Féry, after overcoming many difficulties, has constructed a novel direct-reading photometer. The selection of the radiations, in the proper proportion, can be effected by various means. For example, the height or width of the spectrum of the light under examination might be limited by the interposition of a screen with its upper or lower edge, or both, in the form of the curve of retinal sensitiveness, as a function of wave-length. It appears simpler, however, to employ an absorbing cell. After trying various substances, Féry chose a solution of copper sulphate as the absorbent liquid and, by modifying the radiomicrometer of C. V. Boys, he obtained an instrument with which exceedingly small quantities of heat can be measured.

The essential part of the new Féry photometer is a



Measuring the candle-power of a lamp with the Féry photometer.

NEW DIRECT-READING PHOTOMETER.

combined galvanometer coil and thermo-electric couple, composed of a coil of copper wire with its ends connected, by means of silver plates, with the ends of a loop of phosphor bronze. The compound coil is suspended between the poles of a magnet by a quartz filament attached to the strip of bronze. The silver plates, which are ¼ inch thick, are brought close together and inclosed in a short thick-walled copper tube, to insure equality of temperature. The plates are polished on one side and coated with platinum black on the other. The beam of light is received on the blackened surface, the adjustment being facilitated by a fringe of paper surrounding the plate. A small concave mirror carried by the bipolar suspension throws a spot of light on a scale at a distance of 2 meters (6½ feet). A deviation of 50 centimeters (20 inches) is produced by the radiation of a candle distant 1 meter (39 inches) from the blackened silver plates, the radiation being allowed to fall on only one of the plates. As this sensitiveness is greatly diminished by the interposition of the absorbing lens, the image of the source of light is projected on the plate by a convex lens, which can very conveniently be moved aside, and brought to cover each plate in succession by compressing two India rubber bulbs, the movement being limited by adjustable stops. By repeating this series of operations at regular intervals, errors due to the gradual displacement of the zero point are eliminated. With the lens and the absorbing cell, a Carcel lamp at a distance of 1 meter (39 inches) produces a deviation of 60 millimeters (2.4 inches). In measuring very powerful sources of light, the sensitiveness must be diminished by interposing diaphragms of known area.

With this apparatus, which is very easily managed, Prof. Féry has already obtained interesting results, some of which confirm the measurements made by the usual methods of photometry. He finds that the optical efficiency of the Bengel burner is only 0.091, while that of the Auer burner is 0.401. He intends to extend his researches to arc and mercury vapor lamps.

The Current Supplement.

The new system of reinforced concrete is described and illustrated in the opening article of the current SUPPLEMENT, No. 1728. The theory that electricity or electrical charge is a kind of matter composed of discrete particles or electrons has steadily gained ground during the last decade. A lucid and popular explanation of the theory is given by Prof. L. Graetz. The possibility of a future fuel supply in the growth of vegetation from the soil is set forth in an article entitled "Alcohol as a Fuel." The recent collision of the "Republic" and "Florida" lends timely interest to the splendid article by Gen. E. E. Goulaeff on unsinkable and uncapsizable ships. About twelve miles from Paris, the French Institute for the Encouragement of Aviation has established a trial ground and race course for aeroplanes and other airships. This is admirably pictured in the current SUPPLEMENT. A new development in the art of indirect color photography is described by Frederick Limmer, and sets forth the details of the Szczepanik process. The strength of wooden poles for overhead power transmission is discussed by our London correspondent. Paraphrasing the remark that has been made about books, it may be said that of the making of many alloys there is no end. Some of our legion alloys are described by Dr. John A. Mathews. The coming return of Halley's comet lends peculiar interest to Irene E. Toye Warner's article "Ancient and Popular Ideas of Comets." The usual electrical, engineering, and trade notes will be found in their accustomed places in the SUPPLEMENT.

Official Meteorological Summary, New York, N. Y., January, 1909.

Atmospheric pressure: Highest, 30.66; lowest, 29.17; mean, 30.14. Temperature: Highest, 57; date, 5th; lowest, 7; date, 19th; mean of warmest day, 50; date, 5th; coolest day, 17; date, 19th; mean of maximum for the month, 39.7; mean of minimum, 26.7; absolute mean, 33.2; normal, 30.6; excess compared with mean of 39 years, 2.6. Warmest mean temperature of January, 40, in 1880, 1890. Coldest mean, 23, in 1893. Absolute maximum and minimum for this month for 39 years, 67 and —6. Precipitation: 3.33; greatest in 24 hours, 1.23; date, 5th; averages of this month for 39 years, 3.76. Deficiency, 0.43. Greatest January precipitation, 6.15, in 1882; least, 1.15, in 1871. Wind: Prevailing direction, northwest; total movement, 10,241 miles; average hourly velocity, 13.8 miles; maximum velocity, 57 miles per hour. Weather: Clear days, 6; partly cloudy, 10; cloudy, 15; on which 0.01 inch or more of precipitation occurred, 11. Snowfall, 9.5. Sleet, 14th, 17th. Fog (dense), 5th, 6th, 22d, 23d, 24th, 25th.

A $10,000 Aeronautic Prize.

The Aero Club of America has just announced the offering of a cash prize of $10,000 by the New York World for a flight by an aeroplane or airship up the Hudson River from New York to Albany. This flight will be made next October at the time of the Hudson-Fulton centennial celebration. The distance is about 140 miles, and when the historic "Clermont" made the journey one hundred years ago, it took 35 hours to accomplish it. A modern aeroplane or airship should do it in about one-tenth of this time.

The exact conditions of the flight and the rules under which it is to be conducted will be announced in the near future. The contest will be in the form of a race, and it is probable that a number of stops will be allowed *en route* for fuel replenishment.

A $250 PRIZE FOR A WET-GRAIN CONVEYING SYSTEM.

The Anheuser-Busch Brewing Association of St. Louis contemplates the installation of apparatus for the purpose of conveying brewer's wet grain, or mash, from the mash tanks located in the brew house to the grain-drying house, which is located about 1,700 feet from the brew house. The relative locations are shown in Fig. 1. Inasmuch as there has been much discussion as to the most economical and satisfactory method of conveying the wet grain, the Anheuser-Busch Brewing Association has decided to invite mechanical engineers to submit plans and specifications covering equipment best adapted in their judgment for the purpose. After these plans and specifications have been received and examined by the management and engineering department, the Brewing Association will award a prize of $250 to the engineer whose plans the management decide to adopt.

We will give in this article a complete description of conditions and sufficient data, that the case may be readily understood by engineers who may wish to submit plans and specifications.

The material to be conveyed is known as "brewer's wet grain." This wet grain is made from malt and rice in the mash tanks in the brew house. The wet grain weighs about the same as water, and contains about eighty per cent of water as it comes from the mash tanks. It must be conveyed at the maximum rate of 100,000 pounds per hour. At this writing the wet grain is loaded into cars, which are switched to the Dried Grain Department, where the wet grain is taken from the cars and dried.

There is now in course of construction a tunnel extending from the brew house to the machine house on Second Street, which is adjacent to the grain-drying department. The dimensions of the tunnel between the brew house and the Second Street ice plant are 10 feet wide and 10 feet high, with a circular top having a 5-foot radius, all inside dimensions. In this tunnel there will be installed ammonia pipes, electric cables, etc., but there will be available space for pipes or other equipment for conveying the wet grain.

The mash tanks are located on the second floor of the brew house. The bottom of the tunnel is about 44 feet above the level line where it leaves the brew house, and is about 6 feet above the level line where it enters the Second Street machine house, or a drop of about 38 feet in the entire length of the tunnel, as indicated in Fig. 2.

As will be seen from Fig. 1, the grain-drying house is separated from the Second Street machine house by railroad tracks. It will therefore be necessary to elevate the mash at the end of the tunnel through a distance of about 50 feet, and carry it horizontally across the tracks at the grain-drying house. At the grain-drying house there will be a drop of 15 feet where the wet grain will discharge into cars. From these cars the wet grain will be handled by the present car-unloading machinery.

It may be considered advantageous to construct a separate tunnel from the machine house to the end of the main tunnel, under the tracks of the grain-drying department, in which case it will be necessary to elevate the wet grain to the car level.

The grain-drying plant is located along the railroad track, and has a side track under cover, and a loading platform alongside of the side track. With the new arrangement of conveying, one or two cars will be used to receive the wet grain, and the cars will be shifted to the proper position for unloading.

The wet grain as it comes from the tank is mixed with water, a considerable quantity of which drips from the cars as they are switched to the grain-drying house.

For plans proposing a system of pumping the wet grain it should be stated that there is no objection to mixing the wet grain with water, but means must be provided for eliminating the greater part of the water mechanically after the mash has reached the grain-drying department.

For purposes of estimating the cost of operation, it may be assumed that the cost of water is five cents per thousand gallons, and the cost of electric power is two cents per kilowatt hour.

Engineers who submit plans and specifications are requested to give details of the apparatus which they propose, and of sizes of pipes, conveyers, or other apparatus used. They are also asked to prepare an estimate of cost of installation, and to give an estimate of the cost of operation.

In all cases engineers are requested to consider electric motors as the motive power, the system in use being the direct-current system, 220 volts. There is ample reserve capacity for furnishing electric power for this new conveying system.

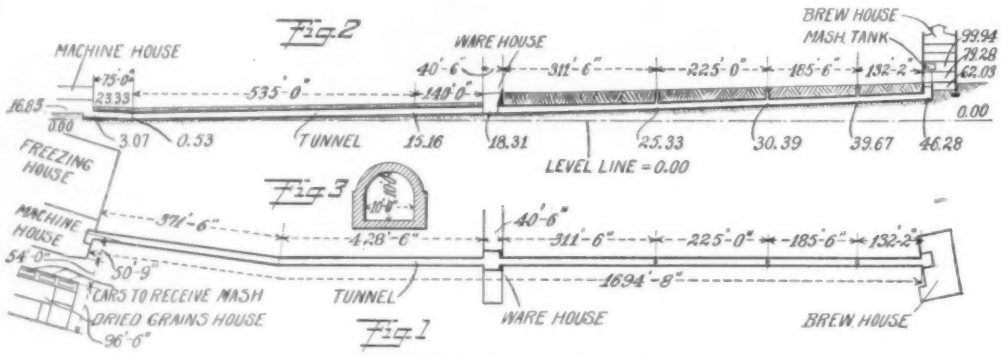
In submitting a report with plans and specifications on the above-described installation, engineers are required to make their report in the following order:

1. General type of system recommended, sizes and details of apparatus recommended, with such drawings and specifications as engineers think necessary.
2. The power required to operate the system, and the estimated cost based on the price of power and water given above.
3. Cost of labor necessary to operate the system.
4. Estimated cost of installation of the system.
5. State experience with the apparatus recommended.

The management of the Brewing Association will give consideration to all reports sent in answer to this invitation, and as stated above will award a prize of $250 to the engineer whose plans they may decide to adopt.

The Brewing Association trusts that this problem may prove of interest to a large number of engineers, and that many replies will be received.

All reports with plans and specifications must be submitted on or before April 1, 1909. *Adv.*



GROUND PLAN OF THE BUILDINGS.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

ELECTRIC SWITCH.—B. W. Macy, Orlando, Fla. The more particular object of the invention is to provide a type of switch controllable by motions of a hand crank and adapted to transpose, merge, and separate a number of distinct circuits at will, so as to greatly simplify the wiring. It may be used in connection with electric lights and house wiring, in such manner that the various electric lamps in the house may be lighted either severally or collectively, and any group or combination of such lights, chosen arbitrarily at will, may be lighted to the exclusion of the other lamps.

ELECTRIC-TERMINAL CLIP.—G. McIntyre, Jersey City, N. J. The object here is to provide a clip which is durable in construction and arranged to permit convenient attachment to the binding post of an electric apparatus, and to insure a strong and exceedingly reliable contact for the proper transmission of electric energy.

Of Interest to Farmers.

MARKER FOR CORN-PLANTERS. — D. Loudenslager, Rising City, Neb. The aim in this case is to provide a double row marker which may be readily adjusted to corn planters now on the market, the disks of the marker being adjustable so that they may be spaced apart to correspond with the width of the planter. By its use the operator is enabled to keep the rows straight and equal distances apart.

CORN-TESTING CABINET.—C. B. Joslin, Manchester, Iowa. The invention refers more particularly to a cabinet adapted to support a plurality of ears in separate compartments; and later a plurality of germinating cups. The number of cups corresponds to the number of ears, so that a few kernels may be removed from each ear and placed in the corresponding cup, and after sprouting, the different seedlings may be identified with the ear from which the kernels were taken.

TRANSFER APPLIANCE FOR BEET-DUMPS.—F. L. Pickett, Rocky Ford, Colo. This appliance is for use in connection with beet dumps for reloading on the grower's wagon, dirt screened from sugar beets, and by it, avoiding the necessity of piling up the dirt at the dump and thereafter handling the same by hand and weighing it, usually entailing services of a special man at the dump for this purpose.

Of General Interest.

TAPE-MOISTENER.—F. E. Francis, New York, N. Y. The invention relates more particularly to that type of construction in which there are provided means for supporting a roll of tape, a moistening surface over which the tape may pass as it is removed from the roll, and a cutting or tearing edge by means of which the moistened portion of the tape may be separated from that remaining on the roll.

DISPLAY APPARATUS.—W. F. Allert, New York, N. Y. One object of this invention is to provide a simple, inexpensive, and efficient display apparatus which is attractive in appearance and compact in form, which can be used for displaying various kinds of merchandise in shop windows, on store counters, and in other places where such exhibits are necessary, which is capable of a plurality of adjustments, and which is inexpensive to manufacture.

Hardware.

PLANE.—W. L. Fischer, Oroville, Cal. The purpose of this invention is to provide a construction capable of making a smooth cut extending the full width of the plane, with the least possible effort on the part of the user. The plane makes it easy for the cutting edge of the blade to be set parallel to the plane-base; and other features of construction which especially adapt the plane for rabbeting and planing floors.

INSTRUMENT FOR SLAUGHTERING ANIMALS.—H. Bergh, New York, N. Y. The instrument is for use in slaughtering animals, notably cattle, and is arranged to permit of forcibly projecting a javelin into the brain of the animal with a view to produce almost instant and painless death, thus rendering the slaughtering humane and obviating any misdirected or abortive blows against the head of the animal.

Heating and Lighting.

BOILER-CLEANER.—H. C. Fabri, Sidhoardjo, Soerabaya, Java. The cleaner has adjustable steam conduits provided with a plurality of nozzles arranged to be directed toward the boiler tubes and permitting steam to escape in jets to remove the soot, ashes, and other accumulations upon the tubes, and further having means for introducing steam into the conduits, and means for adjusting the conduits to direct the steam jets in different directions, the conduits being located in recesses in walls of the boiler to protect the conduits from gases of combustion.

Household Utilities.

FOLDING CHAIR.—O. W. Potter, Wauconda, Ill. This invention more particularly applies to folding chairs such as are especially adapted to be removably secured to the walls of a room or hall, and which have folding seats and front legs. It is inexpensive to manufacture and can be used either secured to a wall or as an ordinary folding chair.

HYGIENIC EATING UTENSIL.—C. M. Daly, G. A. Weidhaus, and W. S. Henry, New York, N. Y. The invention pertains to improvements in eating utensils adapted to lunch counters and the like, and relates more particularly to a construction involving a plurality of utensils adapted to be dispensed from a suitable container, and so simple and inexpensive to manufacture as to permit of their being thrown away after being used once.

Machines and Mechanical Devices.

DISPENSING-CONTAINER.—W. A. Kirkpatrick, Abbyville, Kan. The object of the invention is to provide a container having means for holding the straws in a closed receptacle, thus obviating dust and dirt coming in contact with the straws. Further, to provide means for releasing one straw at a time and further means for catching the straw thus released and holding it so that it may easily be taken by the user.

MECHANISM FOR OPERATING CIRCULAR NEEDLES.—J. Larsen, Silkegade 13, Copenhagen, Denmark. Mr. Larsen's invention relates to a sewing-machine using a curved needle to which is imparted a movement so that it becomes possible to force the needle through the sole leather without boxing holes previously, thereby making it possible to attach the soles without any preliminary work or treatment whatever.

SELF-PROPELLED TORPEDO.—A. E. Jones, Fiume, Austria-Hungary. The metal cage forming the casing, and the cage of the motor, comprises at the lower part an excess thickness extending throughout its entire length, in order that by increasing the stability of the torpedo and the rigidity of its shell in this way, the steadying ballast and the angle irons for reinforcing the casing may be dispensed with wholly or partially, with the object of diminishing the weight of the torpedo, while rendering the casing capable of resisting corrosion for a longer period.

FLYING-MACHINE.—H. Bea, Jersey City, N. J. The aim in this case is to provide an aeronef or flying machine of the heavier-than-air type, and arranged to permit the operator to readily control the working parts for raising, lowering, and propelling the machine in the desired direction, maintaining it in equilibrium and allowing easy landing without shock or jar.

CIGAR-LIGHTER.—J. C. Raymond, Brooklyn, N. Y. In the handle of the device—which may appropriately have the general form of a pistol—a reel of wick and a reeled strip of paper caps are arranged, the wick and cap strip being guided to the perforated forward end of the device. The movements of a trigger are made to advance the wick and cap strip and explode the cap.

Railways and Their Accessories.

BALANCE-VALVE.—B. F. O'Bryant, Collinsville, Ala. The valve is more especially designed for use in locomotive engines, and arranged to secure an easy movement of the valve with the engine running or dead, and without danger of bonding, and to allow of conveniently and quickly replacing a worn out bushing in which the controlling piston valve travels.

SAFETY DERAILING DEVICE.—F. Pélissier, Gonaives, Haiti. The device is such as carried by locomotives or cars for use in preventing accidents from collisions. The object is to derail a car or locomotive to which the device is attached. It embodies an arrangement for normally supporting a derailing skid near the rail just in advance of the forward truck.

Pertaining to Recreation.

TOY BASKET-BALL DEVICE.—S. J. Hartnell, Oswego, Oregon. The device when in use partakes of the character of the basket ball game, and is particularly well adapted for the amusement of young persons; the successful manipulation of the toy requiring dexterity and skill, training the hand and eyes, affording agreeable exercise, and also amusement to the players and those interested in the game.

Pertaining to Vehicles.

SHOCK-ABSORBER.—G. R. Rogers, New York, N. Y. The invention relates more particularly to a shock absorber including an inflated pneumatic cushion acting in conjunction with the springs of the vehicle. The object is to provide a pneumatic cushion and inclosing casing therefor, so constructed as to render the absorber readily adaptable to any form of vehicle already in use.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Full hints to correspondents were printed at the head of this column in the issue of November 14 or will be sent by mail on request.

(12008) S. L. D. asks: In your column "Answers to Inquiries" will you oblige a 45-year reader of the SCIENTIFIC AMERICAN by stating scientists' explanation of the great weight of the earth? Astronomers say the whole weight is 5½ times that of water: viz., about 344 pounds per cubic foot. Marble and the densest granite rarely exceed 180 pounds per cubic foot. By far the largest part of the earth known to man is much less in weight than granite; for example, water, earths of all kinds, coal, all woods, etc. If astronomers are correct, a few hundred miles down and thence to the center of the earth there must be great density of matter. A. It is true that the average density of the materials on the earth's surface is not greater than three times that of water. The weight of a cubic foot of such materials then is not far from 180 pounds per cubic foot. Your inference is the only possible one, that the interior of the earth is much heavier than the surface portions. Nor is this any different from what would be expected, if once the earth were fluid. At that time the heavier substances sank to the bottom of the fluid mass, and are at present nearer the center of the earth.

(12009) E. E. W. asks: In corresponding with an electrical dealer about hand-power for running a 75-watt dynamo, he said that it could not be run by hand-power, it was too large. This dynamo at 1,400 R. P. M. will furnish 15 to 20 volts; at 2,000 R. P. M. will furnish 40 to 50 volts. In a circular I have there is a 75-watt dynamo advertised. This dynamo will furnish an alternating and direct current at the same time or separate. It will run as a motor on a direct current and at the same time furnish an alternating current to light lamps by. In all other respects it is the same except in design. The questions in my mind are why cannot the first dynamo be run by hand-power if the one can that I last described? Does it take more power to run a dynamo as you increase the amount of current or the voltage? If a dynamo is run at a higher speed than it was designed to run, would there be a higher voltage or amperage? A. A 75-watt dynamo can be run by hand, by one-man power, for a while. It is one-tenth horse-power. And a strong man can exert more power than that for a short time. It matters not how the 75 watts are made up—1 ampere at 75 volts, or 3 amperes at 25 volts, or any combination which gives 75 for a product. Power is in watts, and these are the product of volts and amperes. If the speed of a dynamo is increased the volts are increased, but the amperes remain the same. All the amperes flow which the resistance allows to flow. The volts depend upon the rate of cutting lines of force by the revolving armature. This is increased by increased speed. But if 1,400 turns per minute give 15 volts, 2,000 turns per minute can only give 22 volts, and not 40 volts as you give it.

(12010) J. A. B. asks: 1. What are the underlying principles of cloud electricity, that is, where do the clouds obtain their electrical energy, and how? A. The mode of the production of electricity in the atmosphere is not yet well understood. No theory completely explains all the facts. 2. What is the cause of lightning and thunder? A. Lightning is due to an electric discharge between two oppositely electrified masses of clouds. Thunder is the sound produced by the shock of the air rushing back again into the space through which the lightning has just passed. 3. Why are not all clouds accompanied by lightning? A. All clouds do not produce lightning because they are not sufficiently electrified to pierce the air between them and the earth. 4. Do all clouds possess electricity? A. All clouds are electrified, so is the air at all times. 5. Are lightning clouds laden with electricity before there is any lightning flash, or is lightning caused by the friction of the clouds? A. Thunder clouds are more highly electrified than other clouds. Light from the electric discharge is due to the heating of the air through which the lightning flashes. 6. What are clouds? A. Clouds are composed of drops of water in the air. These drops always fall, as do any other drops, but they may evaporate and disappear before they reach the earth. They may be kept up by currents of air under the clouds, raising them and keeping them from coming through to the earth. Otherwise it would rain every time a cloud passes overhead. 7. Steam circulating in pipes condenses and again becomes water. Then why is it that steam escaping into the cold atmosphere rises and finally becomes invisible? Why does it not condense and fall back to the earth in the form of water? A. Clouds are not vapor or steam, but actual drops of water. Steam when it comes out of a pipe and is seen as a cloud is no longer steam but drops of water. If these drops disappear, it is because they evaporate into the air. They often fall as water, wetting the ground below. You would profit by reading some good book on meteorology. Waldo's "Meteorology" is good. We can send it for $1.75 by mail.

NEW BOOKS, ETC.

THE STEAM TURBINE. By James Ambrose Moyer, S.B., A.M. New York: John Wiley & Sons, 1908. 8vo.; pp. 370; 225 ill. Price, $4 net.

It is the aim of the author to give what practical engineers and students desire to know about the steam turbine and not merely a *résumé* of as much of thermodynamics and mechanics as is necessary coupled with particulars from manufacturers' catalogues. The result, while essentially a book for the engineer is eminently practical, more for the designer and builder than for the theoretical mathematician and sufficiently lucid to be interesting to the amateur. Nothing could be clearer, for instance, than the author's explanation of the difference between impulse and reaction turbines in the accepted commercial sense of those names, a distinction so confusing to many on account of the misleading nature of the terms, practically all successful turbines using both impulse and reaction in their exact sense. The summary of the difficulties of design for gas turbines is also admirably clear. The rapidity of recent developments is perhaps best shown by the introduction almost without comment of entropy diagrams laid out in lines of constant superheat instead of in constant temperature and by the quite unimpassioned assumption that no reciprocating engines will in future be used for large electric power plants. The presentation of the most important statements in bold-faced type is an innovation reminiscent of advertising circulars, but is useful in making the subjects visible at a glance.

PEERLESS ALASKA. Our Cache Near the Pole. By Charles Hallock, M.A. New York: Broadway Publishing Company, 1908. 16mo.; pp. 224. Price, $1.25.

This is Mr. Hallock's latest work, written in his 75th year. It is a timely and very entertaining volume of 250 pages, comprising a comprehensive outline of the physiography, ethnology, natural history, products, railroads, government enterprises, experimental farms, and economic resources of Alaska and its development from cession to date, and furnishes a useful and trustworthy *vade mecum* for intending homesteaders, miners, mushers, commercial fishermen, sportsmen, missionaries, and all persons interested in its settlement and advancement. There is an introductory send-off by Rev. Sheldon Jackson, of the U. S. Bureau of Education, vouching for its accuracy and scope.

LABORATORY ARTS. By George H. Woollatt, Ph.D., F.I.C. New York: Longmans, Green & Co., 1908. 12mo.; pp. 192; 119 diagrams.

This is a teacher's handbook, adapted particularly for the science teacher who has to take care of and repair his own instruments. The work is thoroughly practical, and is based upon the personal experience of the author in caring for his laboratory apparatus. The book abounds with useful suggestions, which clearly show the resourcefulness of the author. The purpose is not to show the standard trade methods, but the best way for the man of limited skill and a poor equipment of tools to make the necessary repairs.

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PATENTS

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Inquiry No. 8943.—Wanted a portable hand machine for breaking stones for installing road surface. To be worked by two or three men.

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Inquiry No. 8945.—Wanted address of manufacturers of casava starch machinery.

Inquiry No. 8946.—For the address of manufacturer or dealer of Floss cotton candy machine.

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Oiler, automatic, Messmore & Severn 911,513
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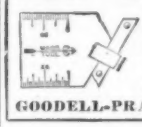

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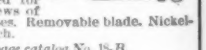

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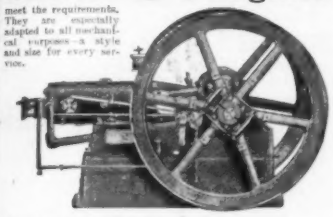

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Remedy for diseases of the urinary organs, P. Astier	72,513
Remedy for hog cholera, Abel & Williams	72,511
Remedy for syphilis, Standard Chemical Co.	72,527
Salves and ointments, C. B. Williamson	72,530
Sauce, Italian tomato, F. Cusimano	72,581
Shoes made wholly or in part of leather, Pingree Co.	72,522, 72,523, 72,570
Silk and silk mixture piece goods, E. H. Behrens & Co.	72,577
Silk, rough surfaced broad, Rogers & Thompson	72,543
Silk piece goods, York Silk Manufacturing Co.	72,544
Snuff, tobacco, and cigars, Strohmeyer & Arpe Co.	72,593
Soap, M. Werk Co.	72,519, 72,520
Soap, toilet, Mulhens & Kropff	72,521
Spices, D. & L. Slade Co.	72,582
Spraying fluids, W. Cooper & Nephews	72,515
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"Elephant Brand," for macaroni, Basilea & Calandra	14,608
"Fenole," for insect destroyer and disinfectant, W. R. Powell	14,619
"Glycoline Tooth Paste," for a tooth paste, Portland Dental Manufacturing Co.	14,615
"HO-LON-OL," for a medicine for external application, J. R. Wilson	14,617
"Ideal," for steel work, American Steel Wool Manufacturing Co.	14,621
"Keno Cigar Scrap," for smoking and chewing tobaccos, Victor Tobacco Co.	14,604
"Lotto Scrap," for smoking and chewing tobaccos, Victor Tobacco Co.	14,605
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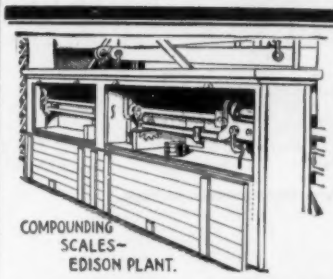

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PLUMBING FOR A SMALL COUNTRY HOUSE, by John A. Gade, is a very important subject. No part of a house needs greater attention than the laundry, kitchen and bath room. Hence the economic and convenient placing of the plumbing fixtures, the kind to use, and the cost of the same are matters of interest to all prospective home builders.

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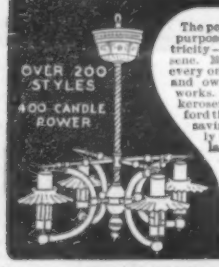

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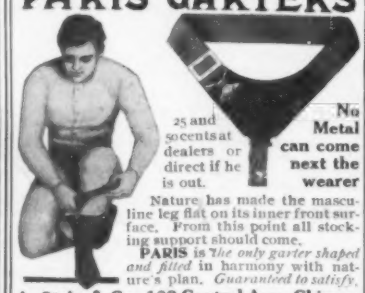

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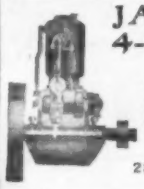

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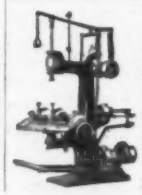

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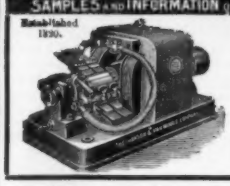

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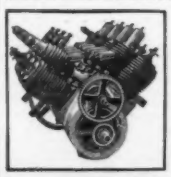

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